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ORIGINAL ARTICLES

En Route to the X-Ray Room.

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SOME OBSERVATIONS OF MASTOID STRUCTURE AS REVEALED BY ROENTGEN-RAY EXAMINATION*

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THE material reported in this paper is the result of some study in the past two years by Dr. F. N. Bigelow of Providence, and the writer. This work was suggested by Dr. Bigelow as a result of his disappointment with the general literature available on mastoid structure. He has made a more detailed report on the study, which will be published elsewhere.

A large part of the clinical literature on mastoid disease published in the past few years regards the mastoid as having essentially a definite type of structure. The authors speak of mastoid disease as if it were really an entity, and discuss the different stages and modes of treating mastoiditis. As a matter of fact an infection of the mastoid is one of the most

FIG. 1. (AFTER CHEATLE.)

Right temporal bone of an infant aged nine months, showing the diploëtic type of mastoid mass in infancy. A = middle ear and antrum, B = mastoid mass, C = outer antral wall.

*Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Chattanooga, Tenn., Sept. 1918.

FIG. 2. (AFTER CHEATLE.)
Temporal bone of infant aged seven months, showing the dense type of mastoid mass. B = mastoid mass, C = outer antral wall.

protean types of disease with which we are acquainted. Specialists with wide experience have come to realize that every case of mastoid infection is a problem in itself; that the clinical course and the indications for surgical interference are widely varied; and that one case can very rarely be compared accurately and in detail with another. Each case presents a distinct problem and a distinct special study. The basis for this wide variation seems to be most probably the existence of marked fundamental differences in mastoid structure.

The use of the roentgen-ray examination in the study of mastoid disease is undoubt-

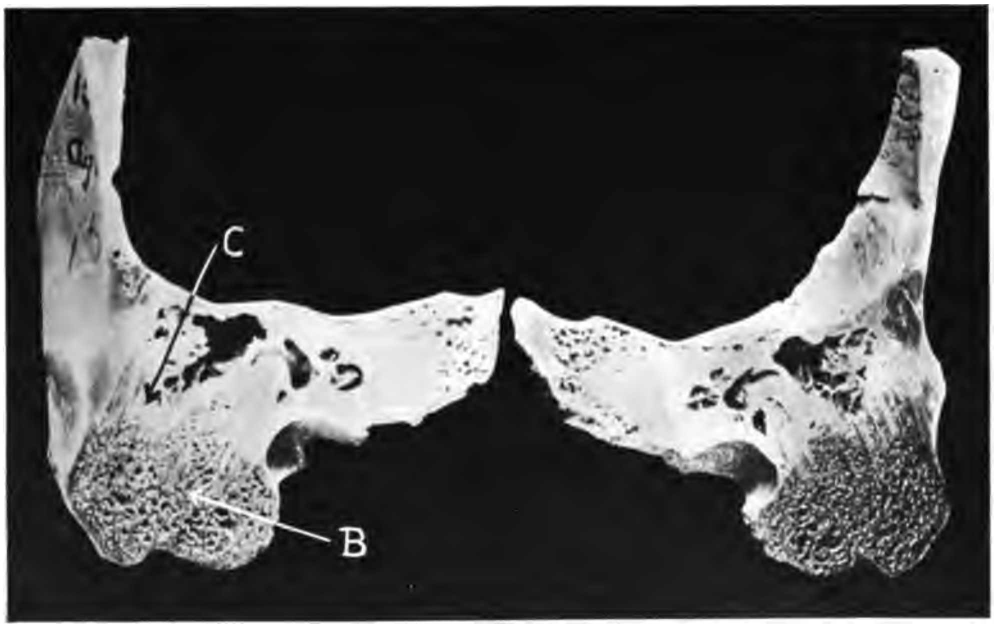

FIG. 3. (AFTER CHEATLE.)
Temporal bone of adult aged 42, showing the persistent diploëtic infantile type. B = mastoid mass, C = outer antral wall.

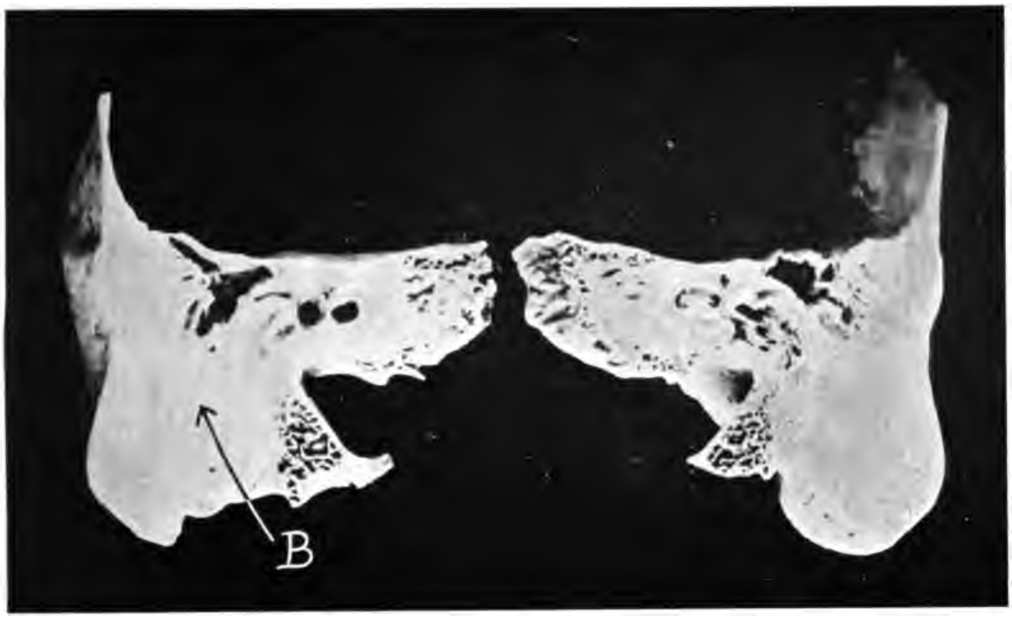

FIG. 4. (AFTER CHEATLE.)
Temporal bone of adult, showing the persistent dense infantile type. B = dense mastoid mass continuous with the outer antral wall.

edly a tremendous help. The pioneer work done by members of our society, notably Lange[1] and Pirie[2], has been of the utmost value in the early detection of mastoid changes. Up to the present, however, the data available through use of the roentgen-ray examination have been chiefly concerned with the size, distribution and approximate number of the mastoid cells, the character of the cell-walls, and the location of the lateral sinus. Little attention has been paid to the general type of mastoid structure.

An attempt has been made to classify the various types, from the roentgen-ray point of view, but this has been slight. The usual classification has been into three groups, the Pneumatic, Diploëtic, and Mixed types. Unfortunately, this classification, while affording some knowledge of the general structure of the mastoid, has not been of any real value to the otologist. It did not aid him either in planning his operation, or in getting an idea of the prognosis in the individual case.

Some years ago, Cheatle[3], an English observer, examined a large number of temporal bones for the purpose of determining the types of mastoid structure in both the normal and pathologic states. The results of his work, while easily available, have not received much notice from the otologists on this side of the Atlantic. It was from an acquaintance with Cheatle's work that Dr. Bigelow was first impressed with the importance of the study of "type" in mastoid structure, and suggested our observation of these types as revealed by the roentgen-ray examination.

Cheatle divided all mastoid structure into two main groups, the Infantile and the Pneumatic types.

In order to appreciate just what the infantile type means it is desirable to study for a moment the structure of the mastoid region in the young infant. (Figs. 1 and 2.) In such a mastoid, a lateral vertical section shows the outer wall of the mastoid antrum to be composed of two essential parts. There is an outer layer of compact bone, known as the outer antral wall, and inside this is a layer of so-called "fetal cells." Below, and external to the antrum, is the mastoid mass itself. This mastoid

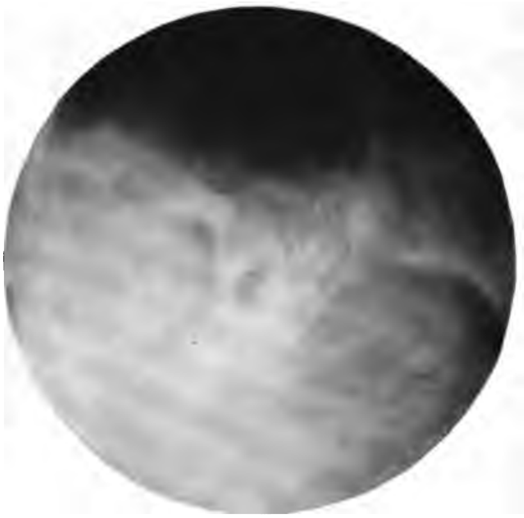

FIG. 5.
A right infantile mastoid, probably Type 1.

mass is generally of two types. In one, the mass shows more or less diploëtic structure. (Fig. 1.) In the other it is extremely dense, with very little structure to be made out. (Fig. 2.)

Now by the "infantile" type of mastoid Cheatle means the persistence of that type throughout adult life, where the appearances of the outer antral wall and the mastoid mass are practically the same as the above-mentioned conditions in infants. As there are two types of infantile mastoid, so there are likewise two general types of infantile mastoid which persist into adult life.

The first type is the diploëtic form of persistent infantile mastoid. This condition was found by Cheatle to exist in about 20 per cent. of all the mastoids which he studied. Such a mastoid in the adult will present an entirely diploëtic condition of the main portion of the body of the mastoid, and an extremely thick and dense outer antral wall. (Fig. 3.)

The second infantile type is the "dense form" as seen in adult life. (Fig. 4.) This is not a very common type, however, and is only seen in one or two per cent. of the temporal bones studied by Cheatle.

These two types of persistent infantile mastoid can thus be seen to make up nearly one-quarter of all the mastoids observed. The common characteristic of these infantile types is the dense outer antral wall. The lateral sinus is generally much more forward than is common in the cellular type of mastoid. It may even reach the posterior meatal wall, or be found between the cavity of the mastoid antrum and the surface. (Fig. 6.) In this type of mastoid the size of the antrum is variable. When it is large, the dense wall will be found only in the anterior portion, while the posterior wall is apt to be very thin. This latter wall is very close to the cerebellum or the lateral sinus.

The operative difficulties in attacking such a mastoid can easily be imagined. The antrum is very hard to find on account of its thick wall which may involve the entire mastoid mass; and complications with the floor of the cerebellum, the lateral sinus, the labyrinth or the facial nerve are not uncommon.

A third type of infantile mastoid is described by Cheatle, consisting essentially

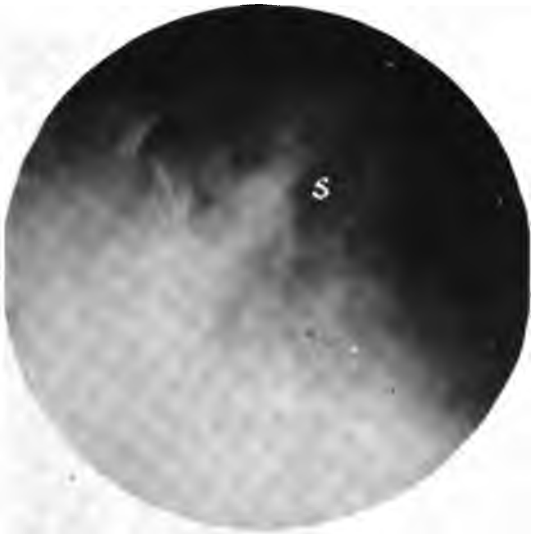

FIG. 6.
A right infantile mastoid, probably Type 2. Several small cells seen back of middle ear. S = lateral sinus, which was found to be extremely superficial at operation.

of a combination of the infantile and pneumatic types, with the infantile characteristics predominating. (Fig. 7.) This may sound rather like an academic distinction. But when I mention the infantile characteristics as predominating, I have clearly in mind the fact that the clinical significance with an infantile type of mastoid is quite different from that encountered in the ordinary pneumatic type.

An acute infection of the mastoid generally starts as an infection of the antrum, by spread from the middle ear through the aditus antri. (Fig. 10.) In the infantile type, with its thick outer antral wall, an infection can continue and develop for a long time with practically no visible external mastoid signs. It may even go on until there are intra-cranial complications through the thin posterior wall, without giving any very marked superficial indications. The natural result of such a course, if a brain abscess or a sinus-thrombosis does not intervene, is the production of a chronic suppurative mastoiditis. This is the bugbear of the otologists. A careful roentgen-ray study of the ordinary cases of chronic suppuration will show that the great majority of them have the infantile type of mastoid.

These cases then run a long subacute course, with very few violent or pressing symptoms. In Type 1 the diploëtic cells of the mastoid mass may eventually become infected through the blood-stream. When this occurs we may have the same sort of acute mastoid symptoms as exist with the pneumatic type, but the symptoms are never so threatening as in the latter, and not quite so prominent.

In the roentgen-ray study of infantile types of mastoid, the exact details of the mastoid structure cannot always be shown. This is obvious, because the penetration of the rays is obstructed by the thick wall, which in Type 2 is extended to a thickening of the entire mastoid. However, there is generally enough information available to be of marked clinical value and significance.

It is generally safe to assume that there is an infantile type present when the lateral sinus is seen far forward, when one finds a characteristic sort of cell distribution,

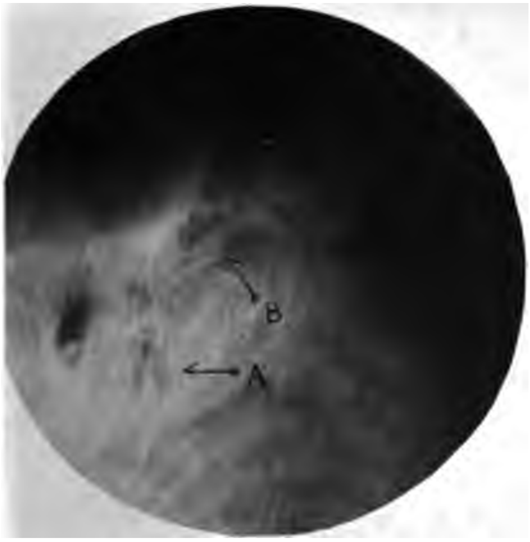

FIG. 7.

Right infantile mastoid in a man of 67, probably Type 3. A few large cells are seen in the tip (A), and along the squamo-mastoid suture (B), probably representing rudimentary pneumatic structure. Compare with Fig. 8.

FIG. 8.

Right mastoid in a girl of eight, showing a few scattered large cells, probably rudimentary pneumatic structure. Compare with Fig. 7.

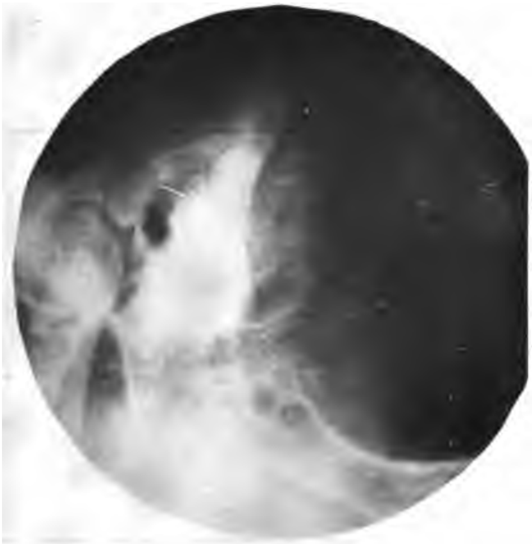

FIG. 9 A.

Probably a Type 2 infantile mastoid. At operation, a chronically infected antrum was found deeply situated in dense bone. The possibility of sclerosis cannot be ruled out here.

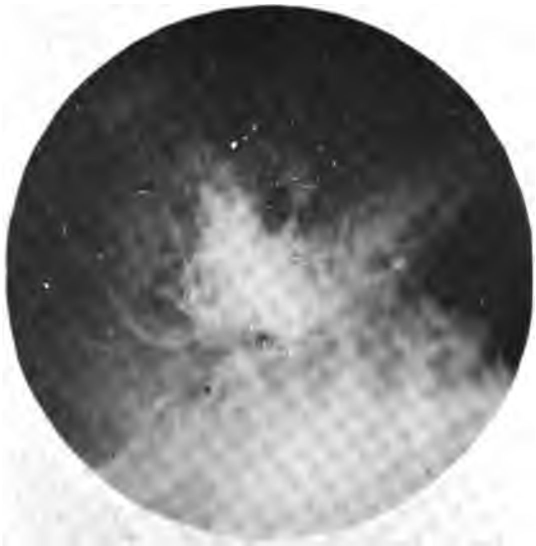

FIG. 9 B.

Normal mastoid, same case as Fig. 9 A. This mastoid is of the pure pneumatic type.

with only a few cells near the tip and a few back of the middle ear or only the latter. In the first instance we are dealing with a Type 1 infantile mastoid, and in the second instance with a Type 2. In such cases, from an understanding of the pathological possibilities, it is desirable to advise early exploration of the mastoid antrum. This is a relatively simple operation, which will avoid the possible complications or the possible transformation into a chronic infection.

The third type of infantile mastoid, in which there is a combination of dense wall with scattered pneumatic cells (Fig. 7), has all the dangers of the pneumatic type with regard to spread of infection, and yet with none of the safeguards that will be mentioned later in discussing the pneumatic type. This is one of the worst types of mastoid to encounter when diseased, and requires prompt antral exploration.

The Pneumatic type of mastoid develops from the infantile type by the projection and development of the antral cells into the mastoid mass through the outer antral wall. The process begins very early in life and progresses rapidly. Stewart[4] some time ago showed that this development of the pneumatic cells is a much earlier process than had been previously realized.

Cheatle divides the pneumatic types into three distinct groups, all of which have distinctive roentgen-ray evidences.

The first type is the pure pneumatic type. (Fig. 10.) It forms the great majority of the mastoids encountered. This is the well-known type in which we see large numbers of pneumatic cells with thin walls, extending throughout the mastoid distribution. The antral wall as a rule is relatively thin, and the tip of the mastoid is usually large, with the larger cells in this portion. Most of the roentgen-ray study has been concerned with this type of mastoid. Here, the evidences of acute infection are generally very obvious. The cells lose their black aërated quality, and appear hazy, due to the secretion. The thin cell-walls become indistinct in outline, and later show the effect of softening or actual destruction. It is in this type that the perisinus and epidural abscesses are brought out clearly by their distinctive shadows

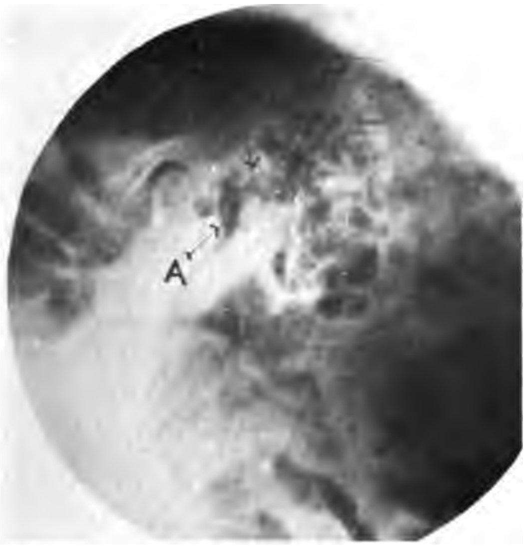

FIG. 10.

Type I pneumatic mastoid. This plate brings out clearly the anatomical details of the mastoid region. Note the relations of the middle ear (A), the a litus antri (B), and the mastoid antrum (C).

in the neighborhoods of the lateral sinus and the squamous bone, respectively.

In this type of mastoid, the onset of the infection is usually abrupt, because of the free communication between the antrum and the large ramifying system of cells. The antral infection generally extends directly into the cells, spreading rapidly to the outermost portions of their distribution. This general infection is responsible for the stormy and threatening symptoms which usually develop so quickly. Sometimes of course there may be a considerable amount of mastoid destruction in this type, without very many clinical symptoms, but it is not common. As a rule infections in this type are easy to recognize by means of the roentgen rays.

The distribution of the cells often brings on interesting complications. Very commonly the cells may extend far forward into the zygomatic process, so as to be in very close relation to the temporo-mandibular joint. (Fig. 11.) In such cases, the infection of these cells will produce a condition closely resembling lockjaw. I have had the opportunity of observing these jaw symptoms in about half a dozen cases, in all of which the mastoid cells were found to be in close relation to the joint. In one instance, a fracture of the zygomatic process of the temporal bone, which ordinarily would be a purely localized process, gave rise in a few days to an acute mastoiditis, from the infection of these anterior, atypically placed cells.

A total and complete destruction of the walls and cellular structure in the pneumatic type will often give rise to an appearance closely resembling the infantile type. Practically no mastoid structure is visible. Very often the differential diagnosis from the roentgen-ray plates alone between the total mastoid destruction and an infantile type is difficult; sometimes it is impossible. The position of the lateral sinus may be of value in the diagnosis. In the infantile type it occupies a more forward position than in the pneumatic type. Often, however, the clinical signs will be of value in the differentiation. Where there is marked mastoid tenderness early, with high temperature and threatening clinical symptoms generally, where the course has been of short duration, with an appearance resembling an infantile mastoid, the chances are

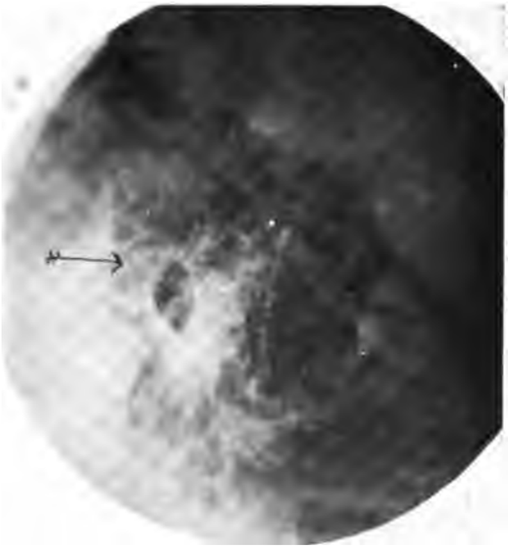

FIG. 11.

Type I pneumatic mastoid, showing zygomatic cells extending to the temporo-mandibular joint.

that total destruction of a pneumatic mastoid is more probable. In either case operative interference is certainly necessary.

In connection with the pneumatic type of mastoid, Dr. Bigelow has formulated an interesting theory to explain the frequent cures by repeated punctures of the drum membrane, especially in cases of large cellular mastoids. At the beginning of the middle-ear infection there is a swelling of the mucous membrane, with consequent obstruction of the Eustachian tube. This cuts off the communication with the atmospheric air. As a result, the air retained in the antrum and mastoid cells is soon absorbed and a condition of negative pressure is produced. This results in venous engorgement and an outpouring of serum. The latter is a fertile field for the development of organisms, and before long the infection spreads rapidly throughout the inflamed area. Now by means of puncturing the drum-membrane the outside positive pressure is reëstablished. As a result the venous engorgement is reduced, and the conditions favorable to infection are gradually removed. Generally this healing process is spoken of as a matter of drainage. If we consider, however, the arrangement of the cells, we can see that simple mechanical drainage does not explain the process. The theory of reëstablishment of positive atmospheric pressure, instead of the negative pressure which is present during the infection, seems a very plausible one. Very often simple repeated paracentesis will bring about a cure in this type of mastoid even though the clinical symptoms may have been marked.

The second pneumatic type is a combination of pneumatic and infantile types, with the pneumatic character predominating. This is the type in which the mastoid mass originally contained a large amount

FIG. 12.

Photograph of a temporal bone, showing a nest of large diploëtic cells in the tip, separated from the pneumatic structure by a layer of compact bone. This is Type 2 pneumatic mastoid. Compare with Fig. 13.

FIG. 13.
Print from roentgen-ray plate of bone shown in Fig. 12. The arrow points to the nest of diploë in the tip, separated by the layer of compact bone. This was much more evident when the plates were studied stereoscopically.

of diploë, which has been pushed downward by the development of the pneumatic cells extending from the antrum. (Fig. 12.) Generally the course of disease in such a mastoid is the same as in the pure pneumatic type, but conditions will be complicated by reason of the presence of the infected diploëtic cells. The recognition of this underlying diploëtic structure is very important, as an operation directed merely towards the mass of the pneumatic cells will not entirely relieve conditions. A secondary operation to drain the diploëtic structure may be necessary. If the combination type is recognized by the roentgen-ray examination, a single operation may be enough to remedy the infection.

The third pneumatic type is the so-called "double-deck" mastoid. This is probably another one of the variations of development in a mastoid with considerable diploetic structure. Here a false inner table is produced, by reason of having an outer layer of pneumatic cells, with an inner deep layer of diploëtic structure. In this type the operator will come down on what he believes to be the inner wall of the antrum, and stop his operation there when, as a matter of fact, a large amount of infected diploëtic structure lies underneath. The detection of such a mastoid,

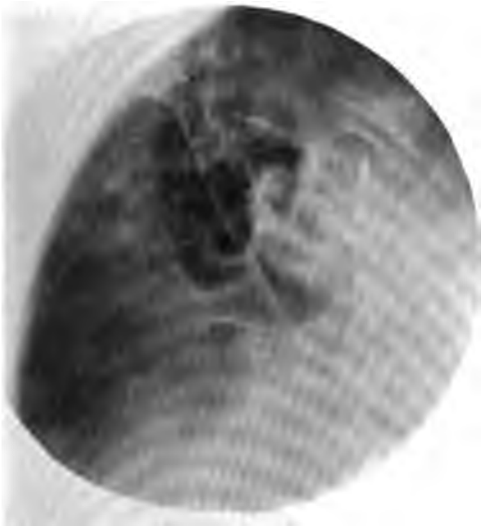

FIG. 14 A.
Left normal mastoid, of Type 1.

FIG. 14 B.
Right mastoid in same patient as Fig. 14 A. Arrow points to apparent diploëtic structure. Stereoscopic study of the plates showed that this was really many large pneumatic cells superimposed.

while possible by roentgen-ray examination, is usually very difficult. In one case, where a previous operation had disclosed a "double-deck" mastoid, a subsequent stereoscopic roentgen-ray study of the other mastoid revealed a condition which was apparently also a "double-decker." At any rate the plates showed what seemed to be an outer layer of cells and a definite inner layer of thin diploëtic structure underlying. Since then two or three cases have been studied in which the "double-deck" condition has been suspected from the roentgen-ray examination alone, and in one case it has been confirmed at subsequent operation.

The consideration of this last type brings out the important point that for a proper roentgen-ray study of these various types of mastoid structure a simple flat plate of the mastoid region is not sufficient. Such a plate may serve generally to bring out the ordinary types of infection visible in the pure pneumatic mastoid, but it will not disclose the complicating types, and will not clearly bring out the infantile types. A stereoscopic study of each mastoid is absolutely essential to the proper interpretation.

One of the points that impresses the observer in the study of mastoid structure is the fact that bilateral symmetry is by no means a fixed rule. Generally, of course, if one type of mastoid exists on one side, the other mastoid will also be of the same type. But this cannot be taken for granted. Frequently a pure pneumatic type of mastoid will be found on one side, and an infantile type, with a dense mastoid mass, on the other. (Figs. 9 A and B.) In the latter instance an infection of the infantile side may produce a difficult case for diagnosis. The presence on the healthy side of a pneumatic mastoid will only be confusing, as it may lead the observer to infer a similar type on the diseased side, and thus erroneously diagnose an extensive destruction on the affected side. In such a case, the clinical findings should be closely regarded, and the position of the lateral sinus studied.

Another important point is the condi-

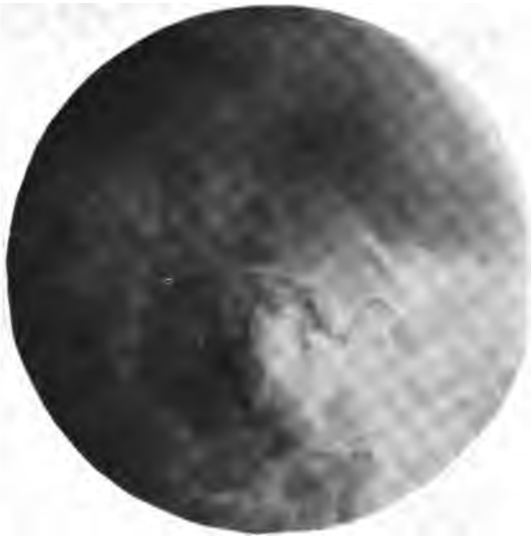

Fig. 15 A.
Normal left pneumatic mastoid, Type 1.

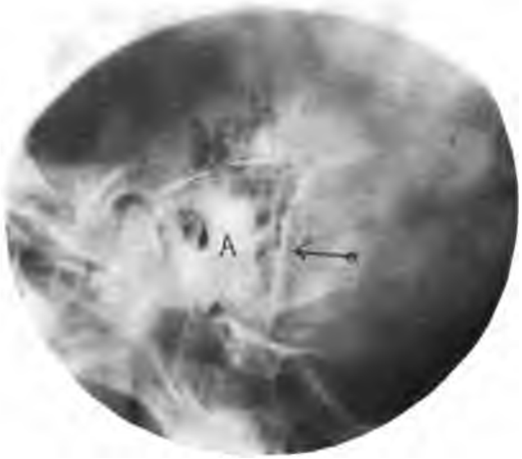

Fig. 15 B.
Right side of same patient as Fig. 15 A. The posterior portion and the tip show probable sclerosis, with a few scattered, hazy cell-remnants. The region of the internal ear (A) is unusually dense, suggesting possible old thickening.

tion of so-called "sclerosis," as detected by the roentgen-ray examination. It has been the habit of roentgenologists generally to speak of a mastoid as "sclerotic" when very little cellular structure was visible. The term sclerosis, when properly used, can be applied only to conditions where there has been actual inflammation, with subsequent repair and new bone production. Now while it is quite true that in some instances a previous infection with such repair has really existed, the majority of the cases that are called "sclerotic" are really mastoids in which no cellular structure was ever present. These are the cases of infantile mastoid that I have described above. A proof of this is the fact that the infantile condition has been found to exist in more than 20 per cent. of all mastoids. In other words, more than one-fifth of all mastoids never had any wide distribution of cellular structure at all. Therefore I believe that the diagnosis of sclerosis should be made very carefully and grudgingly, and always with the possibility in mind that we might be dealing with an infantile type. In this connection we must remember that the true distinction can only be made accurately by microscopic examination of the dense piece of bone after operation, to see if there are any evidences of pre-existing inflammation. However, the mere suspicion from the roentgen-ray study that we might be dealing with an infantile mastoid is enough to draw attention to the condition, and to put the otologist on guard against the possible hidden complications that may exist with this type.

To sum up then, the roentgen-ray examination of the mastoid, with due regard to the distinction of structural types, can help us to predict with much greater exactness the clinical course and prognosis of a middle-ear infection.

In the infantile types, by recognition of their presence, a chronic infection of the mastoid can be prevented by early drainage of the antrum, regardless of the absence of the classical mastoid signs. If there is merely a middle-ear suppuration, with definite drooping of the posterior-superior canal wall, and an infantile type of mastoid disclosed by the roentgen-ray examination, the patient should be given the benefit of the doubt by early antral exploration.

With the pneumatic type of mastoid, however, even in the presence of stormy symptoms, operation should not be hastened at the outset. The reëstablishment of positive mastoid pressure by means of proper punctures of the drum-membrane may be sufficient to produce prompt cure. Of course if actual destruction of the cell-walls, or the presence of a perisinus or epidural abscess, can be made out, then the indication for operative interference is definite.

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A CASE OF HYDRO-PNEUMO-CRANIUM, WITH AIR IN THE VENTRICLES

BY HOLLIS E. POTTER, M.D.

CHICAGO, ILL.

A REPORT of the following case is made available through the courtesy of Dr. B. F. Lounsbury of Chicago, whose associate, Dr. P. F. Thuresson, obtained the first set of roentgen plates. The patient was then referred to me for further observation, and later to Dr. Harold N. Moyer, who made a complete neurologic study.

On May 20, 1918, the patient, Mr. J. H., aged 40 years, fell from a height of 15 feet, striking mainly on his hands and face. He was taken to a hospital and was found to have sustained a fracture of the radius and dislocation of the semilunar, a fracture of the mandible, and a contusion of the forehead with probable skull fracture. There was no loss in consciousness and no more pronounced nervous symptoms than a bitemporal headache which lasted but a week. Since this time there have been a slight dizziness and a little positional discomfort, particularly on bending the head forward.

The patient convalesced rapidly, so that on the nineteenth day he was sent to Chicago for some corrective work on his jaw and wrist. In the routine roentgen-ray examination of his injuries, the skull plates disclosed a frontal skull fracture which could be described as a comminuted, somewhat stellate fracture, centering about the right supra-orbital arch, and involving both the internal and external walls of the frontal sinus and the orbital plate, without appreciable depression of fragments. Inside the cranium, at the site of fracture, there was evidence of gaseous accumulation, in volume and shape comparable to a small hen-egg (see Fig. 1). This was considered rather startling, since the patient's head injury had at all times been in the background, practically all symptoms being those referred to the fractured jaw and wrist.

At this time, which, again, was nearly three weeks after the injury, in the absence of signs of hemorrhage, infection or intracranial pressure, it was decided not to interfere surgically, but to keep the patient under observation, and to make such further studies as would be permitted without danger to the hair and skin. So far, the appearance was that of a simple intracranial air-bubble, quite similar to that reported by Skinner under the title, "Intracranial Aerocele." In the latter case there intervened meningitis and death, thus preventing subsequent observations which might have disclosed the fate of the cavity and the fate of the air. Our interest in the present case centered about the later studies which were made possible by the continued life and health of the patient.

After an interval of two weeks, conditions had changed appreciably. There was considerable increase in the volume of the sub-dural gas chamber, and the lateral ventricle was also partially gas-filled. These facts were demonstrated by laterally projected plates made with the patient lying on his side (see Fig. 2). But in these plates there was not the high degree of transparency through the aerocele that there had been previously, which suggested strongly that the dependent portion of the cavity might contain fluid. Accordingly a screen examination was made with patient standing and head upright. In this position a distinct horizontal fluid level was seen, the fluid filling practically the lower half of the cavity. Now, using the well-known tactics for studying cavities which contain both air and fluid, the patient's head was placed in several successive positions, always with a horizontal fluid level resulting. (See Figs. 3 and 4.) Under the screen, the fluid could be seen to splash with any sudden movement of the head. The splashing was audible. As a record of these changes in fluid level, roentgen plates were made laterally through the head, both in the

sitting position and with head bowed forward on the table. It was thought advisable to use filters and intensifying screens for the protection of the patient.

From this time on the air disappeared, whether by absorption or expulsion is not certain, so that the screen and plate records of July 25 show no evidence whatever of the cavity. The exact date of complete disappearance was not obtained, owing to the temporary absence of the patient on a visit.

Cases of recognized intracranial air are extremely rare in the literature of medicine. The meningitis or abscess usually found on autopsy has made the presence of air interesting, mainly on account of its possible rôle in introducing infection. It is probable that many cases of intracranial air are overlooked because of the infrequency of roentgen-ray examination two or three weeks after the injury, where pneumatic sinuses are fractured into. Should this examination be made as a routine, I have no doubt that in a short time we should have a complete knowledge of the hydrostatics involved, with an answer to the speculative inquiry hereinafter contained as to the rôle of air in the formation of cavities which give symptoms long after-

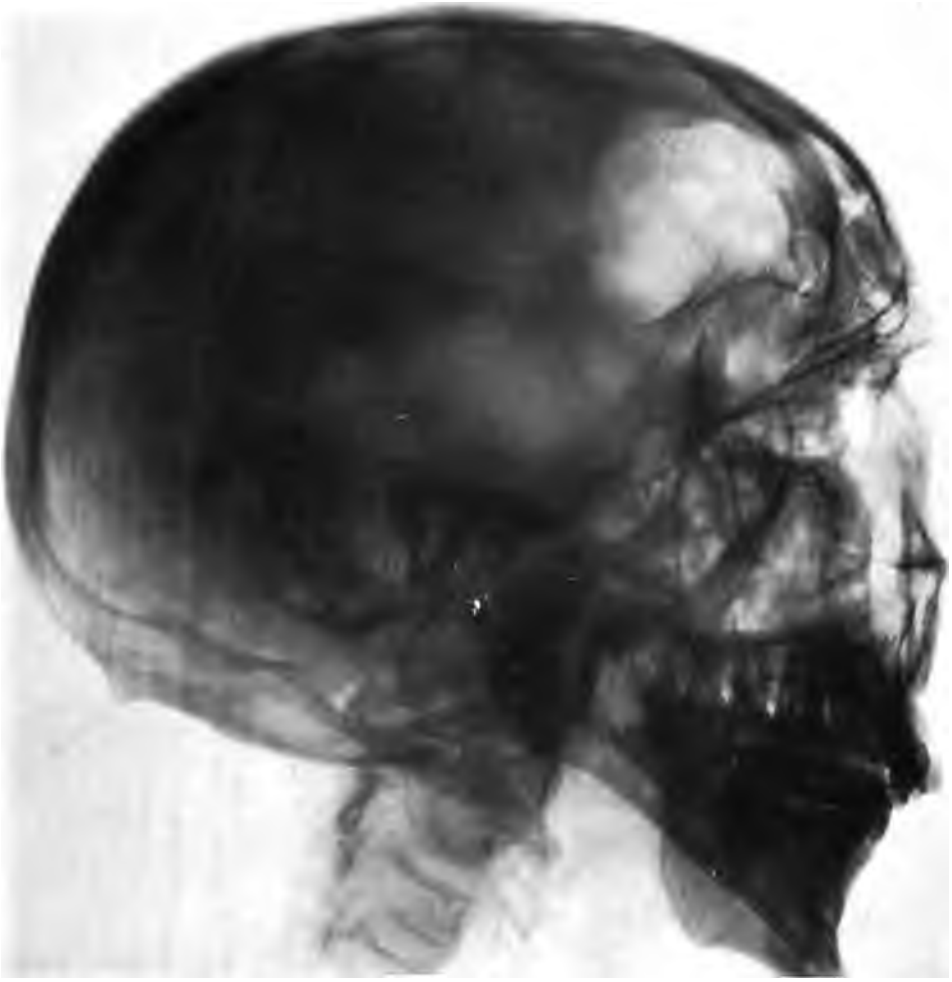

Fig. 1. Dr. Thuresson's Demonstration of Comminuted Supraorbital Fracture and Intracranial Air-Bubble.

ward and are classified among the traumatic cysts.

The mechanics of these cases should be considered alongside our previous knowledge of the external pneumatoceles, a review of which was made by McArthur in 1905. He collected 33 cases of which 23 were in relation to the mastoid, and ten to the frontal sinus. Ten developed after a trauma and in ten, also, there was evidence of pre-existing bone disease. Such bone disease was considered a predisposing factor to the development of pneumatocele after slight trauma. Besides trauma, some history of increased air-pressure in the buccal and oral cavities was frequently obtained. Before the days of roentgen rays, reports of intracranial emphysema and gaseous tumors of the brain are recorded as occurring even in the middle of the last century, but they are not very illuminating.

Luckett, in his first case of air in the ventricles, mentions the appearance of air after a fit of sneezing, accompanied by a copious discharge of fluid from the nose. Stewart's notes show that there was no sign of intracranial air in this case on the first set of plates made after injury. Luckett concluded that air obtained direct entrance into the ventricles at the time of this rise in intrasinus pressure, and the autopsy confirmed the probability of this route by disclosing torn brain coverings and lacerated brain tissue. In our case of to-day, wherein there was first a sub-dural collection of gas and later a partial transfer to the ventricle, there is reasonable ques-

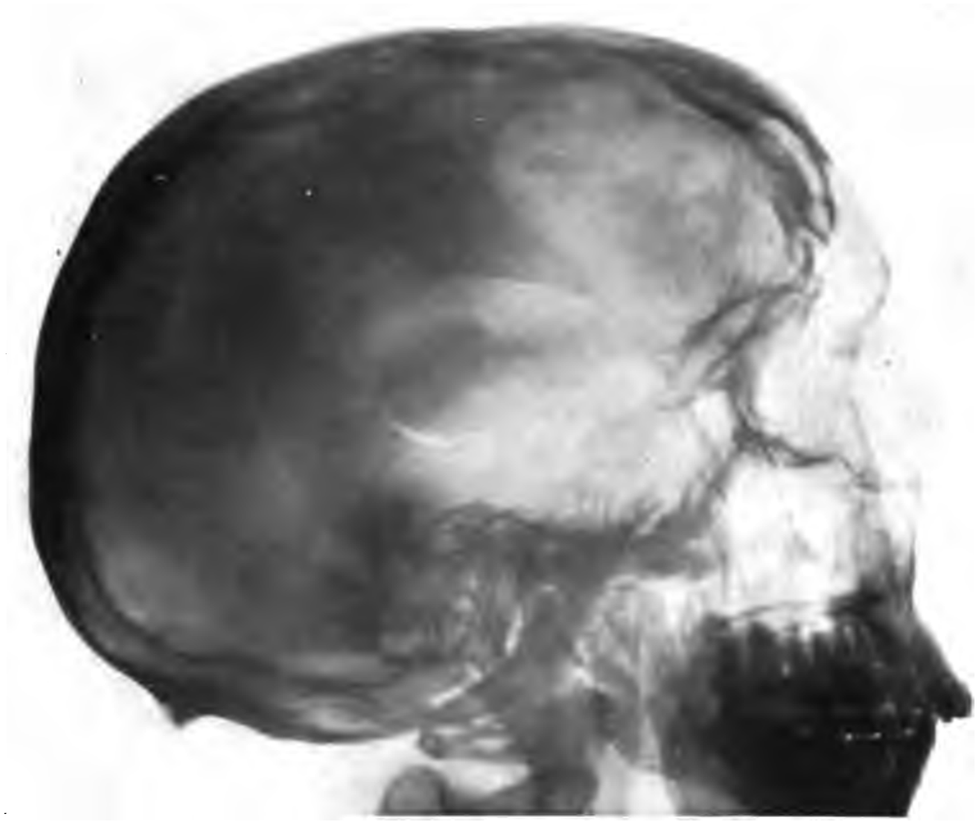

FIG. 2. MORE EXTENSIVE BUT LESS TRANSPARENT SUB-DURAL GAS CHAMBER WITH VISUALIZATION ALSO OF LATERAL VENTRICLE.

tion whether the air did not gain entrance to the ventricle by the roundabout passage formed by the foramina of Magendie and Luscka, the fourth and third ventricles and the foramina of Munro.

The character of the fluid in our case must be a matter of speculation, although in the absence of signs of infection, and in view of the fact that it appeared secondarily to the formation of the aerocele, it seems most probable that it was simple cerebro-spinal fluid. In this connection it is striking to note that the cubic contents of this cavity, roughly figured, were about 70 c.c. Frazier's average of the estimates of five investigators is about 95 c.c. for the total quantity of cerebrospinal fluid. The estimates range from 62 to 150 c.c.

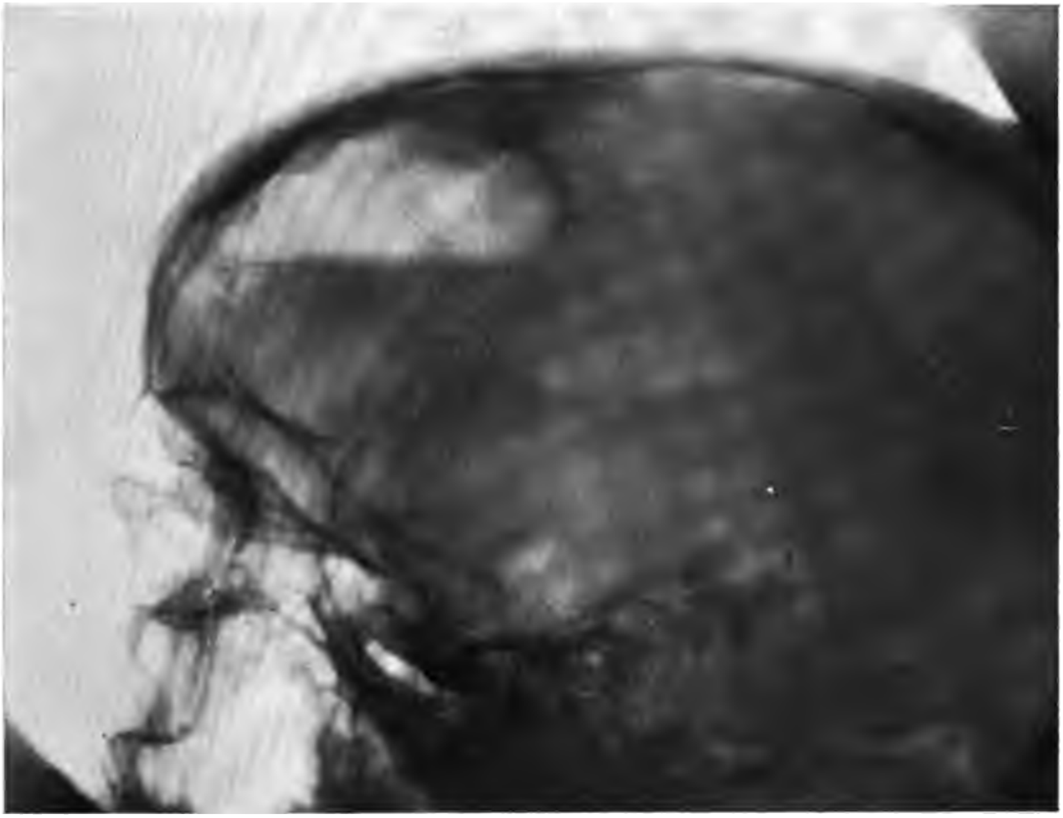

FIG. 3. AIR AND FLUID LEVEL SHOWN IN FRONTAL GAS CHAMBER AND IN LATERAL VENTRICLE, PATIENT SITTING UPRIGHT.

SUMMARY

Reviewing the succession of events in our recent case, we note that a number of days after the injury, air entered the cranial cavity. Two weeks later the cavity formed by this air had extended, but had become partially fluid-filled. With the entrance of fluid the cavity did not shrink concentrically, did not really become smaller as a cavity, but the air was gradually displaced by fluid, and it is no speculation that at this stage there existed a fluid-filled cavity very like a cyst. Judging from the completeness with which all gas disappeared, one would believe it had been expelled as well as absorbed, since a nitrogen residue is said to persist for some time after the oxygen content of air has become absorbed.

One is led to suspect from this chain of events that air insufflated into the cranial cavity, following fracture through pneumatic sinuses, could easily play an important rôle in the formation of certain traumatic cysts either filled with cerebro-

FIG. 4. PATIENT'S HEAD BOWED FORWARD ON THE TABLE. NOTE SHIFT IN FLUID LEVELS FROM THE POSITION IN FIG. 3.

spinal fluid alone or this fluid mixed with hematogenous elements. One would expect symptoms to arise from such cysts more often when in relation to the mastoid than to the frontal sinuses, whose adjacent frontal lobes are notoriously silent.

A search through the literature on traumatic cysts reveals a few cases in which the above theory might well explain the original method of cyst formation. The following case, reported by Phemister in *Chicago Surgical Clinica* of October, 1917, is suggestive: A boy of 12 had been struck back of the ear by a wagon pole four and one half years previous. A bad fracture had been sustained which ran down to the mastoid, very possibly through it. Before operation, basal headaches had been present for one year and epileptic seizures for four months. Operation revealed a large cyst centering at the mastoid region. Phemister says:

> The method of cyst formation is also of great interest. We know from the history that the meninges and brain were lacerated—also that at operation the cyst extended deeply into the brain substance, apparently bordering on the lateral ventricle, and that no trace of convolutions could be seen on its walls. Hence it seems quite certain that the cyst developed within the injured brain substance. The source of fluid is a matter of conjecture, but it probably came from the choroid plexus, bordering on the inner wall. The cyst cavity was completely shut off by adhesions from the pia arachnoid space, consequently the fluid could not have come from this source.

In this case, if one assumes that air might have played a rôle in the formation of the cavity, it is easy to understand how the fluid may have gained entrance and become locked in by adhesions which formed either during, or subsequent to, its collection.

A ROENTGENOLOGIC CONTRIBUTION TO THE POSSIBLE CAUSE OF HEREDITARY OPTIC ATROPHY*

BY HENRY K. PANCOAST

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HEREDITARY optic atrophy, or Leber's disease, may be described as a hereditary condition of unknown origin characterized by a partial or nearly total loss of vision. It may be of sudden or gradual onset, affecting males more frequently than females and occurring at certain rather definite periods of life. The characteristic features upon examination are an absolute central scotoma (Figs. 1-2); and by the ophthalmoscope a pallor of the disks, especially the temporal halves, without evidences of inflammatory changes such as exudates or hemorrhages. The retinal vessels are normal. Evidence points to a symmetrical retrobulbar etiological factor. The patient usually seeks the ophthalmologist because of failing vision. Leber suggested a neuropathic group of cases with additional secondary manifestations such as frontal headaches, vertigo, and epileptiform attacks.

History.—This disease has been recognized for a century. In 1871, Leber published an exhaustive monograph on the subject, collected all the cases in literature up to that time and gave to the condition the name of hereditary optic atrophy.

Onset.—It is usually quite rapid, but the time may vary from a week or two to several months between the first noticeable manifestations and the maximum loss of vision.

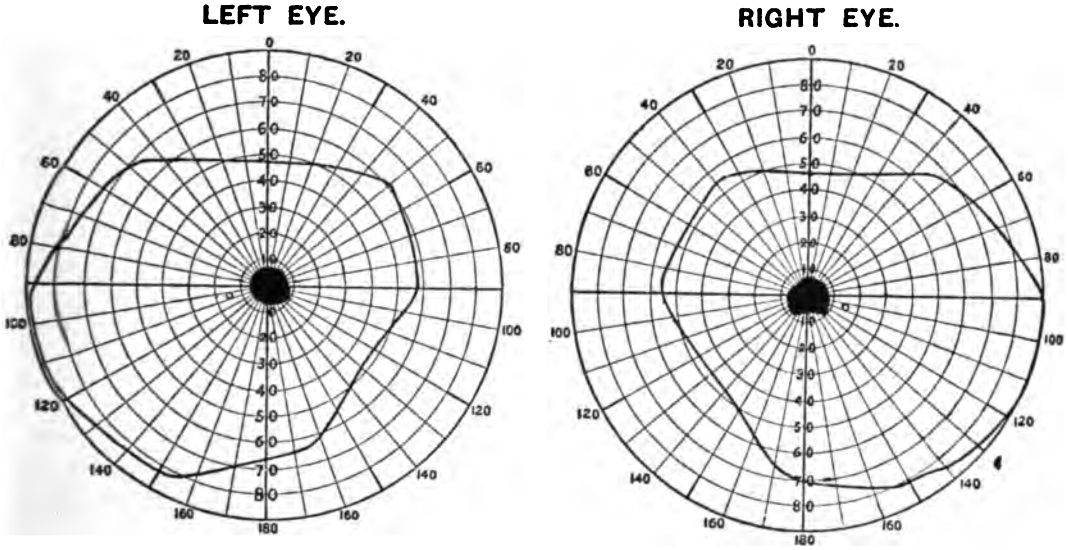

FIG. 1.

Age.—The earliest age for the attack is about the time of puberty. In males the condition is usually manifest in the second or third decade. In females it is perhaps more prone to occur at or about menopause. We have had occasion in the preparation of this article to refer to two

* Read at Nineteenth Annual Meeting of The American Roentgen Ray Society, Camp Greenleaf, Ga., Sept. 4, 1918.

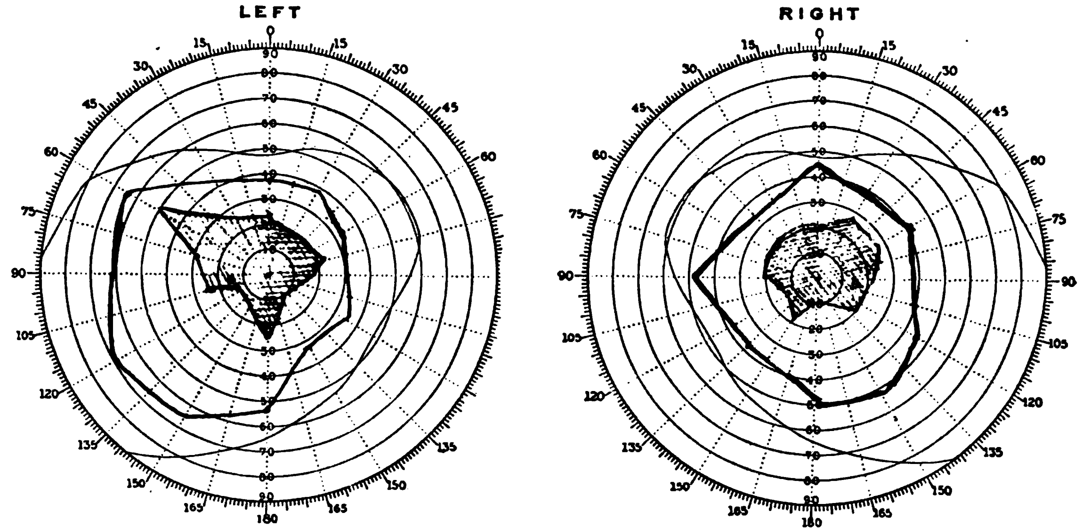

FIG. 2.

authors. In several generations of a single family, in the series of cases reported by Hancock[1] in 1906 (Fig. 3), the youngest was seventeen and the oldest forty-one. Fisher[2] reported a sister and brother affected at the ages of eleven and one-half and twelve years respectively.

Sex.—Usually only the male members of the family are affected and the condition is transmitted through the female members, as is generally the case with familial diseases. This is well illustrated in the accompanying diagram (Fig. 3) of the family tree of cases reported in Hancock's paper[1] published in 1906, which gives full references to literature up to that time. When females are affected, they may be attacked at the same ages as males, but are said to be more frequently stricken at or near menopause. According to Leber, the condition is more severe and more acute in females.

Prognosis.—Complete blindness is uncommon, the peripheral fields usually remaining intact, or contracted. Sight may be regained, frequently to a slight extent, occasionally to a considerable extent, and rarely almost completely. In the twelve cases in the family series of Hancock, six recovered, and this he states is a very unusual proportion. One eye may recover and the other one may not. None of our cases reported as affected typically has shown evidences of recovery.

Pathology.—The cause of the condition is not known. Tobacco, alcohol, or syphilis has little or no influence. Many reported cases were non-smokers, total abstainers, and the possibility of syphilitic infection could be eliminated. Whatever the cause, it must be retrobulbar, and if the chiasm is affected, or the tracts, it would have to be almost if not quite symmetrical. Our reasons for suggesting a possible etiological factor were: Firstly, by certain constant and fairly definite roentgen findings in several typical cases occurring in two different families; secondly, an apparent conformity between these findings and some suggestions as to the possible cause of the condition advanced by Fisher[2] in 1916. The hypothesis advanced in his article would seem to depend to a considerable extent upon future roentgen investigations, of which there seems to have been a dearth up to the present time.

Fisher calls attention to the facts that the phenomena observed in Leber's disease must be explained by retrobulbar changes comprising an atrophy following

a neuritis and affecting the two nerves symmetrically and practically synchronously on the one hand, and a hereditary tendency becoming manifest at certain ages on the other. The usual causes of retrobulbar neuritis are difficult or impossible to apply under such conditions. Cases of pituitary disease frequently develop a central scotoma with ultimately a hemianopsia by expansion, though this is not always the case as the scotoma often starts in the upper and outer part of the field and may later involve the macula. Fisher presents a hypothesis of a possible disturbance of the pituitary body of temporary duration and moderate degree as an explanation of the phenomena of hereditary optic atrophy. If such a condition were possible, the inherited tendency would seem to be more likely a liability of the pituitary body to a transient disorder than a special vulnerability of the macular fibres of the optic nerves to inflammatory attacks. If his hypothesis is in any way correct, facts must be discovered in support of it. If it be found correct, there might be some hope of combating the condition by organotherapy.

The following are the more important points advanced in support of Fisher's argument: There is a similarity between certain symptoms of pituitary disorders and the neuropathic type of Leber's cases—namely, frontal headaches, vertigo and epileptiform attacks. The pituitary functions are intimately related to those of the sexual glands and might be expected to be especially liable to inherited tendencies. Leber's disease very frequently is manifest at or about the age of puberty, and in the female not infrequently at the time of menopause. At the sexual epochs there may be changes occurring in the pituitary body as physiological processes; these processes may be exaggerated in Leber's disease, with tumefaction. During pregnancy the pituitary body may become enlarged, and hemianopia may result. The relations of the pituitary body and the chiasm are very close, with only the diaphragm sellæ between; the latter may vary greatly in density and be so thin as to permit a very slight enlargement of the gland to impair the function of the nerve. Cases of Leber's disease with glycosuria have been reported. It is alleged that in some reported cases with pituitary growths a very early, slight transient papillitis has been detected.

Fisher reported two typical cases of the disease, one a boy, in whom the condition was manifest at the age of twelve, and the other his sister, at the age of eleven and one-half years. In the former the roentgen

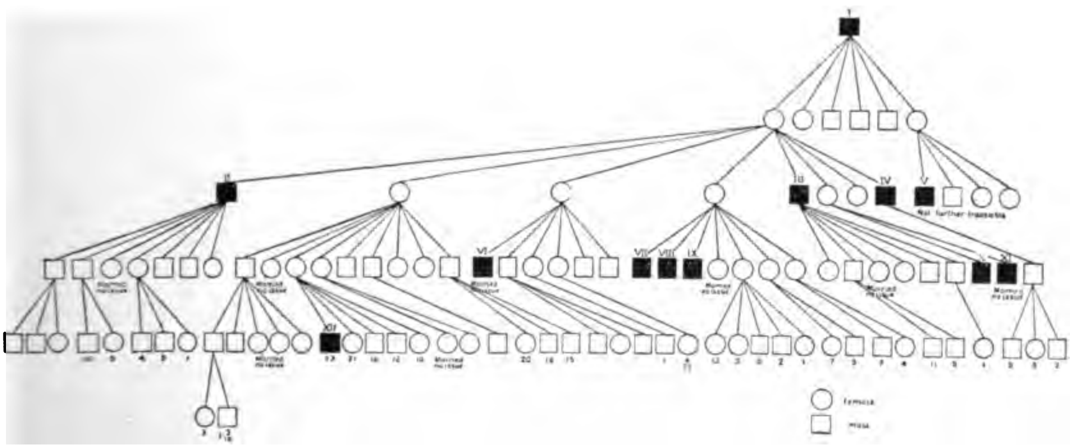

FIG. 3. THE BLACK SQUARES INDICATE AFFECTED MEMBERS. THE NUMBERS OVER THEM CORRESPOND WITH THE CASE NUMBERS IN THIS PAPER. THE FIGURES BENEATH THE LOWEST TWO LINES GIVE THE PRESENT AGE OF THESE MEMBERS OF THE FAMILY.

FIG. 4.

examination was negative. In the latter, repeated roentgenograms showed a sella without undue enlargement or deformation, but the fossa was filled in by a cellular honeycomb-like shadow and the appearance was regarded as distinctly abnormal. He believed that further roentgen study might throw some light on the etiology of the condition and lead to the determination of some corrective measures.

Since the publication of our own cases by Dr. William Zentmayer (3-4), our attention has been called to an abstract in the *American Journal of Ophthalmology* for August, 1918, of an article by Pollock, who reported two cases of Leber's disease occurring in a brother and sister. Roentgenograms of the sellæ showed almost identical appearances in both. This was a shadow about the size of a very small bean with the concavity downward and situated in and a little below the centre of the fossa. There was relative improvement following organotherapy. The reference was not given.

Through the courtesy of Dr. William Zentmayer we have had the opportunity of examining five cases of Leber's disease among the members of two families. We are indebted to Doctor Zentmayer for the privilege of reporting these cases in connection with the roentgen findings.

CASE I.—C. C., male, aged 30. Gradual failure of vision when 29. Typical manifestations of Leber's disease. A roentgen examination of the head was made during my absence. On looking over the plates subsequently, without knowledge of the condition, the pituitary fossa appeared noticeably large but not pathological and the case was passed as probably negative, since we were under the impression that a pituitary growth was suspected. Measurements on standard plate: A. P. dimension 10 m.m., depth 11 m.m. (Fig. 4).

CASE II.—J. C., male, aged 36, brother of Case I. Gradual failure of vision at 30. Typical manifestations of Leber's disease. Again, not knowing the exact condition for which the patient was examined, we reported a slight enlargement of the sella turcica, past the borderline of normal in depth and anteroposterior direction, probably indicative of a beginning growth. Measurements on standard plate: A. P. dimension 13 m.m., depth 12 m.m. (Fig. 5).

CASE III.—E. S., male, aged 23; second family. Gradual onset beginning at age of 20. Typical manifestations of Leber's disease. Roentgen report: Sella turcica large and deep and on the borderline of normal size. Floor and posterior clinoid processes thin, but not out of proportion to the base and vault. No deformation of posterior processes. Measurements on standard

FIG. 5.

plate: A. P. dimension 13 m.m., depth 12 m.m. (Fig. 6).

These three cases were informally reported before the Philadelphia Roentgen Ray Society, and it was the consensus of opinion of the members that the fossæ were certainly on the borderline of normal and possibly beyond. It was thought best to examine some normal members of the families for comparison before drawing any more definite conclusions. Three members of Family II were subsequently induced to come for examination by Doctor Zentmayer, with the following results:

CASE IV.—F. S., brother of Case III, aged 27 years. Gradual failure of vision at the age of twelve, which has not been recovered. Typical manifestations of Leber's disease (Fig. 2). Roentgen report: Sella turcica possibly within normal limits of size but about on the borderline. No evidence of unusual pressure. Floor and posterior processes thin, not out of proportion to the rest of the skull but distinctly thinner than the normal brother (Case V). Measurements on standard plate: A. P. dimension 12 m.m., depth 10 m.m. (Fig. 7). No other members of this family were known to have the disease.

CASE V.—C. S., third brother in Family II, aged 21 years, and exhibiting no evidences of Leber's disease. Roentgen report: Sella turcica undoubtedly within normal limits of size, and much smaller than in any of the other three members of the family. Floor and processes of normal thickness actually and relatively thicker than in the two affected brothers. Measurements on standard plate: A. P. dimension 9 m.m., depth 9 m.m. (Fig. 8).

FIG. 6.

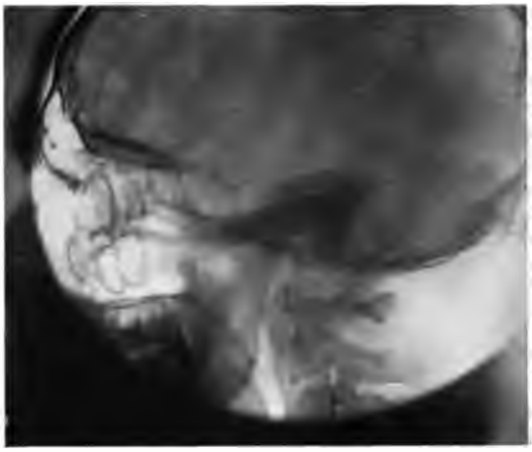

FIG. 7.

CASE VI.—Mrs. M. S. E., married sister of Cases III-IV-V, aged 29 years. She was supposed to have no evidences of Leber's disease. Roentgen report: Sella turcica rather large and on the borderline of being abnormal in size. Floor and posterior processes much thinner than Case V, appearance practically the same as in the two affected brothers. Measurements on standard plate: A. P. dimension 12 m.m., depth 10 m.m. (Fig. 9).

Following the examination of the unaffected Case V, the roentgen appearances in all cases examined seemed to us very suggestive of a pituitary etiology for the condition. The examination of Case VI, however, a supposedly unaffected female, rather discouraged our views, until the fact was recalled that perhaps the majority of females do not exhibit manifestations of the disease until the time of menopause. This seemed a long time to wait for confirmatory evidence; nevertheless, we felt rather confident that this individual might become a victim later on. She became alarmed at the unusual interest shown in the others of the family, at the condition

FIG. 8.

already existent in her two brothers, as well as our request for an examination of her head, and consulted Doctor Zentmayer. She complained of "momentary obscuration of vision, a great deal of headache, and annoying sweating of the left side of the head." Report of Doctor Zentmayer: "Right optic papilla normal; the left showed all but the outer border obscured and slightly prominent. Central lymph sheath full. The visual fields showed decided concentric contraction for form and color, with a minute central relative scotoma in the right field, and an equally small paracentral relative scotoma in the left. Five days later no scotoma could be demonstrated in the left field." Neurological examination negative except for the left-sided sweating.

This case presented very suggestive evidence of pituitary trouble but not typical evidences of Leber's disease, though it seemed quite possible that the phenomena might be early manifestations of the condition in the fundus and field changes, but without optic atrophy. Under the circumstances, this case may be regarded as lending weight to our argument rather than against it.

Conclusions.—No satisfactory cause has been proven for hereditary optic atrophy. Fisher has advanced the theory that it might be due to a transient disorder of the pituitary body with enlargement occurring at definite epochs of sexual life. The roentgen examination would seem to be the most certain means of proving his contention, provided the enlargements were sufficient and of a necessary prolongation to produce a perceptible sellar deformation. Our studies of the affected members of two families would tend to lend weight to such an etiological factor, but cannot be regarded as proof positive.

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FIG. 9.

ROENTGEN-RAY EXAMINATION OF THE URETERS*

BY JOHN H. EDMONSON, M.D.

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HOW many of us some few years ago suffered the unpleasant looks and, many times, unkind remarks of our surgical friends when forsooth the cocksure ureteral calculus failed to reveal itself on a perfectly good roentgenogram. How many were relegated to the category of those unskilled in the art of interpretation before Kelly, Braasch, Furnis, Hunner and others demonstrated that here also symptoms could belie the finished touch of the roentgenologist.

The most prevalent ureteral conditions coming under the roentgenologists' observation are calculi, angulations and strictures.

The subject of calculi has been gone over so thoroughly within the past decade that it hardly behooves the writer to discuss it. Yet in passing, I want to emphasize the theory advanced by Hunner, of formation based upon local infection followed by gradual accumulation, rather than recent after formation within the pelvis.

Angulations may be the result of malformations in development, but as a rule the cause may be attributed to some traumatism, to adhesion from without the ureter or to dislocations of the kidney and hydronephrosis.

The symptoms produced by an angulation are very similar to other occlusions, but the urinary findings are less liable to show evidence of pathology. The pain produced is of a similar nature, but the passage of catheters is, in the average case, more difficult than in stricture.

The principal thing of interest occurring to me within the past two years in the ureteral region is the occlusion by stricture; its cause and variable effect.

To my mind, it is hardly practical to assert that this abnormality is due to any one cause; a stricture is nothing more nor less than scar tissue and from a standpoint of etiology may be divided into the traumatic and the infectious.

Under the traumatic, may be mentioned those produced by injury occurring during labor or surgical operations, in passing calculi, and from gunshot and stab wounds.

Under the infectious I shall include the tubercular and gonorrheal as well as that produced by a distal focal infection. To quote Hunner: "The majority of the ureteral strictures, excluding those of tubercular origin, should be classified as simple chronic stricture. They usually have their origin in an infection carried to the walls of the ureter from some distant focus such as diseased tonsils, sinuses, teeth or intestinal tract."

Symptoms.—The predominating symptom created by ureteral stricture is pain. In the average run of cases this can be traced by careful history to arise near the point of occlusion, but it is the unusual case that one should have in mind in all vague abdominal pains.

For example, what chance has an innocent appendix, should a pain occur deep seated in the right lower quadrant, especially where there is evidence of gastro-intestinal disturbance such as nausea and vomiting and aversion to food? Or the kidney is suspected, the appendectomy is delayed and urinary analysis shows a complete negative and a good clear roentgenogram declares 90 per cent against the presence of a stone; one knows just how much further the average investigation would go.

Of course in the average case of ureteral stricture the urine shows evidence of pathology, but a lack of this has no special significance. When pus is present to any great extent the symptoms are not so remote and can be found more definite in the kidney region.

*Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Chattanooga, Tenn., September, 1918.

Where marked constipation is present, pain is often experienced in defecation.

In some instances the pain strikingly simulates pelvic inflammatory disease and is extremely difficult to differentiate. In other cases the pain cannot be described other than as a deep ache without definite location, and with negative urinary findings can readily be mistaken for almost any abdominal condition.

Some authorities claim that the roentgen-ray is not necessary for a diagnosis but is merely used as an adjunctive convenience. I fail to understand how differentiation can be made between the impression made upon a wax bulb by a stricture and by a small calculus which will permit easy passage. In all cases where the occlusion is sufficient to prevent anything more than an injection of thorium passing, I cannot see how any conclusion can be formed relative to the condition of the ureter and the kidney above.

I have nothing new to offer from a standpoint of technique, but wish to emphasize to beginners the extreme necessity of draining as thoroughly as possible all urine from the ureter and the kidney before injecting. I would also suggest that the catheter be withdrawn very near to where the stricture is suspected and, by a little suction on the syringe just before the plate is made, to fill the ureter as completely as possible with the injection.

This paper is a plea for making a routine practice of thorough ureteral investigation before operating upon cases which do not demand immediate attention.

CASE I. Miss L. W. Age 36. Has always suffered at time of menstrual periods. Has suffered continuously with indigestion for several years. Has been treated for all her symptoms, including bladder troubles, at times for more than six years. She has gradually lost weight and has never been entirely relieved of pain. She is referred as a gynecological patient with pain in left ovary and left upper abdomen, especially at or near time of menstrual periods.

Pelvic examination shows left ovary somewhat enlarged and very tender, otherwise normal. Urine drawn per catheter shows occasionally pus and red blood cells; hyaline cast found rarely. Complains of great pain in bladder at times, with constant desire to urinate in the afternoon and early part of night.

Operation shows the kink to be due to retroperitoneal adhesions from some previous inflammation (probably in the colon).

These adhesions are freed, ureter is sutured up in a straight line, the kidney left alone notwithstanding the fact that it is little lower than normal.

No other treatment carried out, but all symptoms are relieved and at the end of four months the patient has gained twenty pounds.

CASE II. (Courtesy of Dr. Hunner.) A case with almost impassable obstruction from below, but in which the characteristic "hang" and scar tissue grating on withdrawal of the wax-bulb were absent. The angulation was due to a fan-shaped band of adhesions suspending the sigmoid bowel to the posterior peritoneum. The adhesions probably followed a severe attack of typhoid fever during girlhood.

CASE III. Mrs. S. T. D. Age 28. Began three years ago to suffer with nausea and vomiting, swelling in abdomen and at margin of ribs on left side. Pain in left side of pelvis with constant desire to urinate. These symptoms would continue two or three days, then subside only to recur in a short time. There was at all times tenderness in left side from pelvis to ribs. This was thought to be due to complications at the time of, and immediately following confinement, three months previous.

The symptoms gradually grew worse and more constant until one year ago she submitted to laparotomy. The left tube, ovary and the appendix were removed, and the uterine ligaments were shortened. As

soon as she was out of bed all the old symptoms returned. She has been under constant medical care and has lost about twenty-five pounds before and since her laparotomy.

Pelvic examination.—Negative, but extremely sensitive in left side.

Bladder.—Urine per catheter shows some blood and large amount of pus. Cystoscope shows an inflamed bladder. Left ureteral orifice is inflamed. Right is normal. Number 6 lead catheter passes to kidney on right side without obstruction. Urine is normal. Left ureter after much manipulation admits a No. 4 lead catheter, blood and pus are both present. Roentgen-ray shows no stone. Silver iodide solution injected. Stricture of ureter dilated; all symptoms relieved.

CASE IV. Mrs. G. L. Age 34. Had a cæsarian section seven years ago. Laparotomy for double pyosalpinx three years ago. Two years ago began to suffer pain in left side around kidney, later in lower left abdomen, also pain in bladder.

Digestive disturbances soon followed. If perfectly quiet for a few days all symptoms are relieved, only to return when she is on her feet for a short time. She has been treated for all her symptoms including bladder irrigation, with only short intervals of relief.

For three months past has had temperature at irregular intervals up to 102° F. Has lost fifteen pounds in weight, complains intensely of digestive distress, pain in left abdomen and bladder.

Catheterized specimen shows few pus cells. Stricture in left ureter dilated and all symptoms relieved.

CASE V. Mrs. R. C. Has had two operations. First, appendectomy. Second, pelvic operation. Not relieved of pain in lower right side. Urine: negative. Stricture located in ureter. Pain removed by dilation.

CASE VI. J. T. C. Passed small stone from bladder some years ago. Has had pain in side since that time. Urine: negative. Diagnosed as appendicitis and gall-stones. Injected kidney revealed ureteral stricture. Pain entirely removed by dilation.

CASE VII. Mrs. J. E. G. Suffered with pain in left side for two or three years. Two months pregnant. Hysterical convulsions. Sent in as epileptic. Urine contained some pus cells. Found stricture of left ureter. Dilated. Relieved of symptoms.

CASE VIII. Mrs. J. H. B. Suffered some years ago with pain in right lower quadrant. Was operated upon for appendicitis; no relief. Following year, oophorectomy. No relief. Some time later passed very small stone from bladder, and was free from pain until two years ago when similar pain in left side occurred. Negative stone findings. Ureteral stricture revealed. Dilated, all symptoms disappeared.

CASE IX. Miss S. 65 years old. Pain in left side costal margin for years which was always attributed to malarial spleen. Urine negative. Two strictures revealed. Dilated, symptoms removed.

CASE X. Mrs. H. Diagnosis—Gall-stones. Ureteral stricture revealed. Dilated and relieved of symptoms.

CASE XI. Mrs. J. W. J. Symptoms of gall-stones. Urine negative. Ureteral stricture high up. Dilated, symptoms entirely removed.

CASE XII. P. M. L. Intermittent pains in lower right side every month at time near but not immediately at menstrual periods. Ureteral stricture found. Dilation gave complete relief.

VENTRICULOGRAPHY FOLLOWING THE INJECTION OF AIR INTO THE CEREBRAL VENTRICLES *

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BALTIMORE, MD.

THE value of roentgenography in the diagnosis and localization of intracranial tumors is mainly restricted to the cases in which the neoplasm has affected the skull. In an analysis of the roentgenray findings in 100 cases of brain tumor from Doctor Halsted's Clinic, Heuer and I[1] have shown that in only 6 per cent. of the cases did the tumor cast a shadow, and in these it was only the calcified areas that were differentiated by the roentgen-rays from the normal cerebral tissues.

In those instances (9 per cent. of our cases) in which a tumor has encroached upon the sphenoid, ethmoid or frontal sinus, the invading portion casts a shadow in the roentgenogram. Such shadows are due to the displacement of the normally contained air by tissues which are less pervious to the roentgen-ray. This group of shadows is of minor practical importance because the growth can be recognized by the destruction of the walls or bony septa of the sinuses.

Since the roentgen-rays penetrate normal brain tissues, blood, cerebrospinal fluid and non-calcified tumor tissue almost equally, any changes in the brain produced by altered proportions of these components will not materially alter the roentgenogram.

Although skull changes are shown by the roentgen-ray in 45 per cent. of our cases and are frequently pathognomonic, on the whole they represent late stages of the disease. As intracranial tumors come to be diagnosed and localized earlier, the value of the roentgen-ray will be correspondingly diminished.

[1] Roentgenography in the Localization of Brain Tumor, Based upon a Series of One Hundred Consecutive Cases. *The Johns Hopkins Hosp. Bull.*, 1916, Vol. XXVII, p. 311. Also: A Report of Seventy Cases of Brain Tumor. *The Johns Hopkins Hosp. Bull.*, 1916, Vol. XXVII, p. 224.

For some time I have considered the possibility of filling the cerebral ventricles with a medium that will produce a shadow in the roentgenogram. If this could be done, an accurate outline of the cerebral ventricles could be photographed with roentgen-rays, and since most neoplasms either directly or indirectly modify the size or shape of the ventricles, we should then possess an early and accurate aid to the localization of intracranial affections. In addition to its roentgenographic properties, any substance injected into the ventricles must satisfy two very rigid exactions: (1) It must be absolutely non-irritating and non-toxic; and (2) it must be readily absorbed and excreted.

The various solutions and suspensions used in pyelography—thorium, potassium, iodide, collargol, argyrol, bismuth subnitrate and subcarbonate, all in various concentrations—were injected into the ventricles of dogs, but always with fatal results, owing to the injurious effects on the brain. Marked œdema, serosanguineous exudate, and petechial hemorrhages resulted. The severe reactions that are sometimes encountered after the intraspinous injection of most therapeutic remedies indicate the dangers even from carefully prepared solutions. A slight acidity or alkalinity may result even in death. It seems unlikely that any solution of roentgenographic value will be found which is sufficiently harmless to justify its injection into the central nervous system. Suspensions are precluded because they are not absorbed.

Ventriculography, therefore, seems possible only by the substitution of gas for cerebrospinal fluid. It is largely due to the frequent comment by Doctor Halsted on

* Reprinted from *Annals of Surgery*, July, 1918.

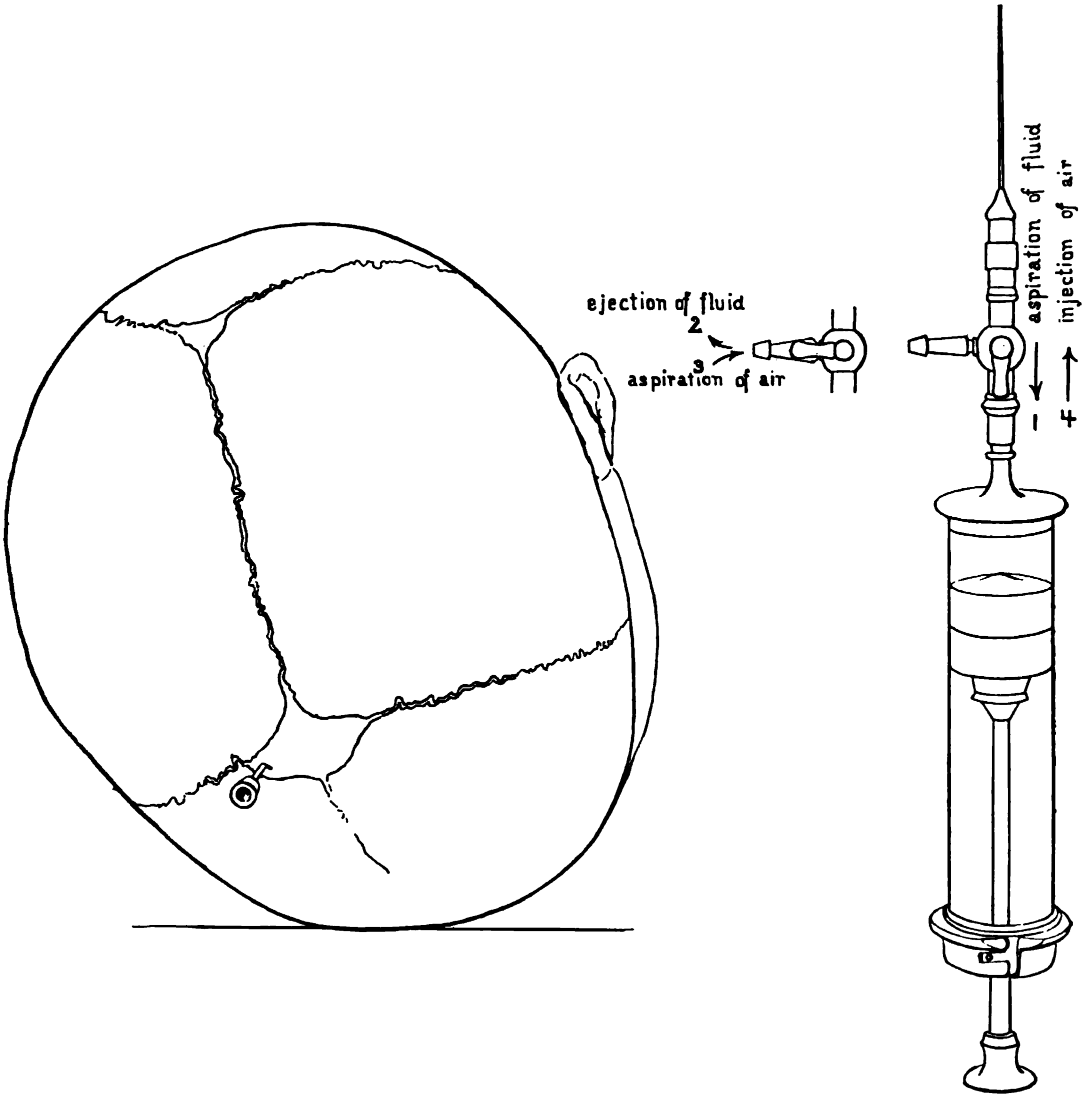


FIG. 1. Showing oblique position of head for aspiration of fluid and injection of air. The forehead is resting on plate. Note point of entrance of the needle into anterior fontanelle on dependent side. Figure on right shows Record syringe and two-way valve attachment used for this purpose.

the remarkable power of intestinal gases "to perforate bone" that my attention was drawn to its practical possibilities in the brain. Striking gas shadows are present in all abdominal and thoracic roentgenograms. The stomach and intestines are often outlined by the contained air, even more sharply than when filled with bismuth. A small collection of gas in the intestines often obliterates the kidney outlines. A perforation of the intestines may be diagnosed by the shadow of the air that has accumulated under the diaphragm. Gas gangrene may be diagnosed by the air blebs (of B. welchii) in the tissues. Pneumothorax is sharply outlined because the normal lung tissues are eliminated. The paranasal sinuses and mastoid air cells show up in a thick skull by virtue of the air, and pathological conditions of the si-

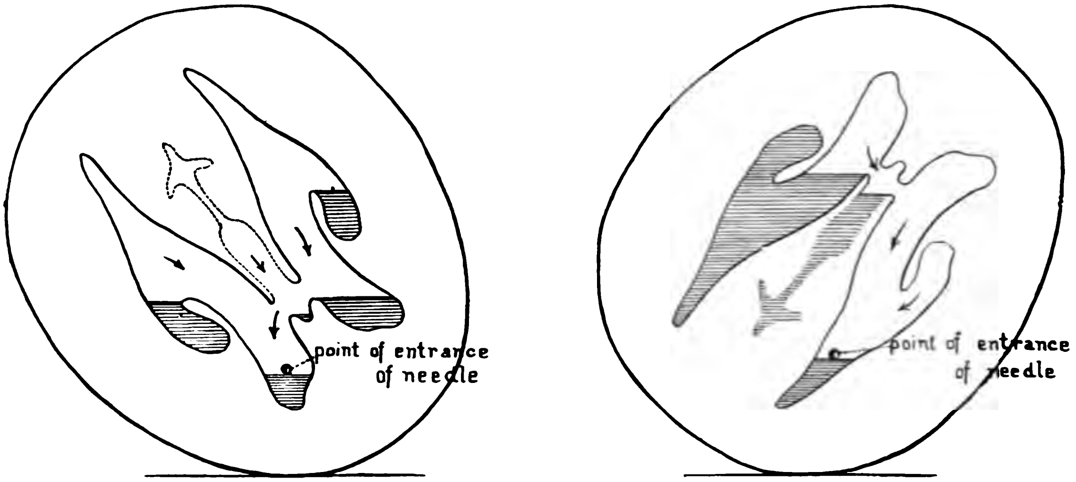


FIG. 2. Diagrams showing relative amounts of cerebrospinal fluid that can be removed from a single ventricular puncture: (1) when forehead is down (*a*), and (2) when occiput is down (*b*). Shaded area represents the fluid which remains in the ventricular system after the greatest possible quantity has been removed. Unshaded area represents maximum quantity of air which can be injected to replace the fluid withdrawn. It is evident that more fluid can be removed when the puncture is made anteriorly and the forehead is dependent.

nuses are evident because inflammatory or tumor tissue replaces the air. From these and many other normal and pathological clinical demonstrations of the roentgenographic properties of air it is but a step to the injection of gas into the cerebral ventricles—pneumoventriculography.

Methods.—Several gases are inert and readily absorbable, and in these respects satisfy the requirements for injection into the cerebrospinal system. Although it is possible other gases give even better results, we have used only air in the injections here described. The merits of other gases are now being studied.

In order to obtain a skiagram of the lateral cerebral ventricles filled with air, it is necessary to remove at least more cerebrospinal fluid than the contents of one ventricle and to replace this fluid with an equal quantity of air. Before closure of the fontanels, one can readily make a ventricular puncture through the interosseus defect. After union of the sutures, it is necessary to make a small opening in the bone.

Air and water in a ventricle behave exactly as they would in a closed flask. Following any change in position the fluid gravitates to the most dependent part and the air rises to the top. Owing to the free communication between the third, the right and the left lateral ventricles through the foramina of Monro, fluid and air will readily pass from one ventricle to the other. Because of the curves in the ventricular system, however, it is obvious that in any given position only part of the ventricular fluid can gravitate to the point of the needle, so that this amount only can be aspirated. If desired, fluid can be removed from the remaining recesses by tilting the head, just as one manipulates a curved tube to replace the fluid with air. Theoretically, it should be possible to remove nearly all the ventricular fluid by suitable manipulations of the head, but for practical purposes enough fluid can be obtained from one correct position. Visualization of the ventricular system will best indicate the most appropriate location for ventricular puncture and the proper position of the head. It will then be seen that the most fluid can be obtained from a puncture in the anterior part of either lateral ventricle (Fig. 2). The head

[NOTE.—*Explanation of Figures.*—Two pictures are shown in each figure number. The first one is the untouched photographic reproduction of the roentgen-ray plate; the other is the same photograph retouched, in order to overcome photographic loss of detail, and especially to emphasize the lines and special points which would otherwise be lost to the reader.]

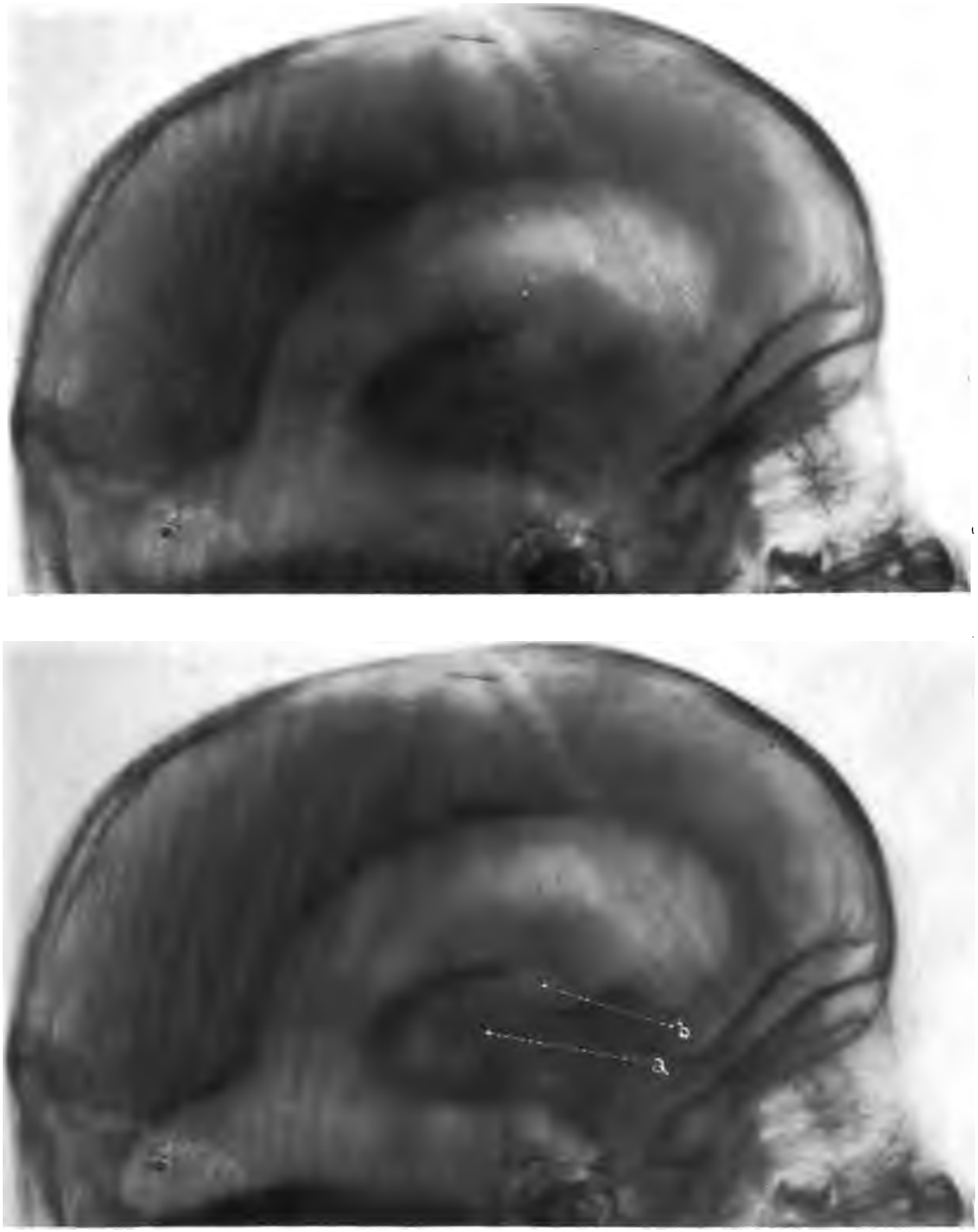


FIG. 3. Ventriculogram in a child three years old, with tuberculous meningitis. The ventricle is slightly dilated, an early obstructive hydrocephalus having resulted from closure of the foramina of Magendie and Luschka by exudate. The separation of the frontoparietal sutures also indicates intracranial pressure. (*a*) third ventricle: (*b*) probably the foramen of Monro. The body, the posterior horn, and the descending horn of the lateral ventricle are obvious.

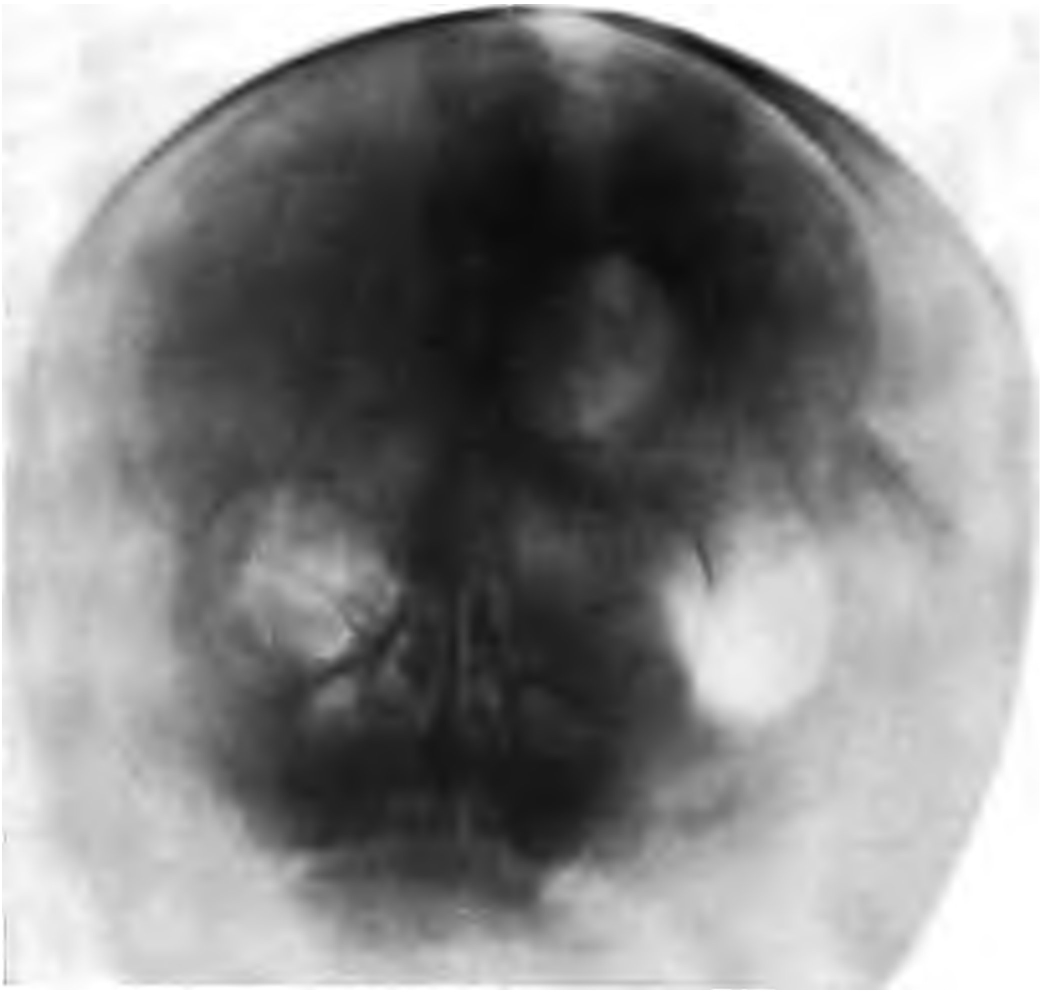


FIG. 4-A. Anteroposterior ventriculogram of Fig. 3. Note the unequal distribution of air on the two sides. The ventricle shadow is greatest in the body and descending horns, owing to the depth of the column of air. The posterior curved and ventrical part of the ventricle shows as a lighter shadow, communicating the two deeper shadows. The shadow is lighter because the smaller column of air gives relatively less penetration to the roentgen rays. The curvature of the ventricles and the perspective are brought out by stereoscopic vision. (*a*) third ventricle.

should be placed with the face down and partially rotated so that the ventricle to be aspirated is beneath and the needle enters at the most dependent point possible. This position permits the maximal drainage of fluid from the opposite lateral and the third ventricles. Aspiration through a puncture in the posterior or descending horn permits a fairly complete removal of the fluid from one ventricle and from that portion of the other lateral ventricle which is anterior to the foramen of Monro. In the aspiration of fluid from the posterior horn of the lateral ventricle, the patient must lie with the face directed upward and backward and the head rotated from 30 to 40 degrees toward the side of the needle.

The exchange of air for cerebrospinal fluid must be made accurately. If the air injected is greater in volume than the fluid withdrawn, acute pressure symptoms

FIG. 4-B. (See description under 4-A.)

will result. To attain accuracy we have used a Record syringe with a two-way valve attachment (Fig. 1). A small amount of fluid (20 c.c.) is aspirated and an equal quantity of air injected. This is repeated until all the fluid has been removed. By aspirating and injecting in small quantities, injury to the brain from negative pressure is prevented. Not knowing the size of the ventricles beforehand, we have no way of estimating the amount of air necessary to fill one ventricle. For this reason we have preferred the removal of all the fluid that can be readily obtained. This has been found to be but little greater than the contents of one ventricle.

Needless to say, owing to the lighter weight of air, the ventriculogram represents the ventricle farthest from the roentgen-ray plate. To insure the best results the sagittal plane of the head should be parallel with the plate. Valuable assistance can also be obtained from anteroposterior roentgen-rays. The head should then be placed so that the sagittal plane is vertical, preferably with the occiput resting on the plate. With the latter precaution a more even distribution of air on the two sides is obtained and the ventriculogram represents the anterior portions of both lateral ventricles. For special points in diagnosis additional anteroposterior views may be

FIG. 5.
Ventriculogram of moderately distended ventricle in a case of communicating hydrocephalus. The size of the head is normal. Note the obliteration of the more normal ventricular contour shown in Fig. 3. The posterior horn is supplanted by a diffuse posterior bulging. The deeper shadow in the anterior part of the ventricle is due to air in the opposite ventricle.

taken of the posterior and descending horns of the ventricle by placing the forehead on the plate.

RESULTS FOLLOWING INJECTION

We have injected air into the cerebral ventricles at least twenty times. In some instances the injection has been repeated. The amount of air injected has varied from 40 to 300 c.c., the larger quantities in cases of internal hydrocephalus. Only once has there been any reaction, and in this case the injection (300 c.c.) was made 48 hours after the first stage of an operation for cerebellar tumor (Fig. 3.). The reaction was characterized by a rise of temperature, nausea, vomiting, and increased headache, all of which were quickly relieved after release of the air by a ventricular puncture. Ten days later, a large cerebellar tumor was removed, the patient making an uneventful recovery. All of the injections have been made in children varying from six months to 12 years of age. Invariably the lateral ventricle has been sharply outlined in the roentgenogram. In two instances the third ventricle and the foramen of Monro were visible (Figs. 3 and 8). In none, however, have we observed the fourth ventricle or the aqueduct of Sylvius. The practical value from pneumoventriculography is expected principally from the shadows of the lateral ventricles.

Day by day the air shadow diminishes

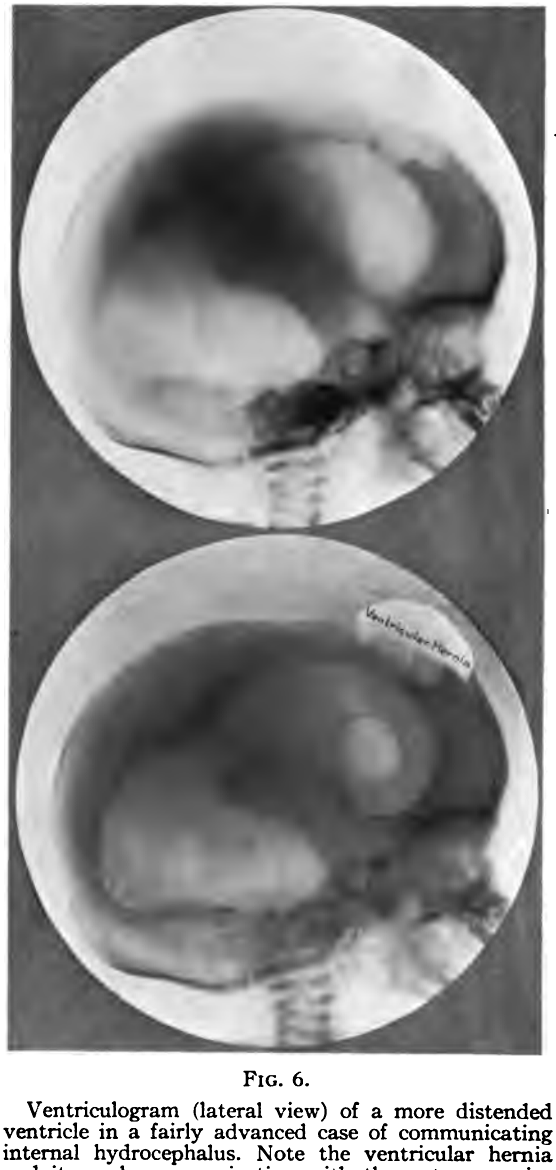


FIG. 6.
Ventriculogram (lateral view) of a more distended ventricle in a fairly advanced case of communicating internal hydrocephalus. Note the ventricular hernia and its neck communicating with the anterosuperior part of the lateral ventricle. It was necessary to draw the hernia in the lower picture because the roentgen-ray shadow of the hernia on the roentgen-ray plate was so slight as to be visible only by an oblique or reflected light. The constriction in the center of the ventricle is due to the fact that air does not fill the ventricle.

and eventually disappears. In a case of internal hydrocephalus it required two weeks. Possibly in more normal cases the time may be less, as air in other body tissues vanishes much more rapidly. In all probability absorption of air injected into the ventricles takes place by the same channels as in the case of the ventricular cerebrospinal fluid. In a previous communication[2] it has been shown that cerebrospinal fluid is almost entirely absorbed from the subarachnoid space; that only a very slight absorption takes place from the ventricles. Phenolsulphonephthalein in a closed ventricular system disappears in from ten to twelve days, whereas it is absorbed in from ten to twelve hours when the ventricles communicate with the subarachnoid space, where the absorption of cerebrospinal fluid normally takes place.

Air introduced into the ventricles acts in no way differently from the air included at every intracranial operation. Following tumor extirpation especially, the resulting defect fills with air which, unless displaced by salt solution, is shut in when the dura and scalp are sutured. For a few days pending its absorption from tumor defects the patient may be conscious of the movement of the air when the head is turned, but its presence is without any other effects.

THE VALUE OF VENTRICULOGRAPHY

Even in the few cases here reported ventriculography has proven of great practical value. For the first time we have a means of diagnosing internal hydrocephalus in the early stages. Internal hydrocephalus is one of the most insidious diseases of the brain and is rarely diagnosed before a considerable amount of cortical destruction has resulted. This is true of adults as well as of children. With exact visualization of the ventricles the findings are pathognomonic. Not only the existence of hydrocephalus but its degree and the amount of brain destruction are at once evident from the ventriculogram.

In one case (in an infant six months old) an internal hydrocephalus was suspected from a bulging fontanel, but the ventriculogram showed no enlargement of the ventricles. Another child (three years old) remained drowsy for several days after apparent recovery from an attack of epidemic cerebrospinal meningitis. The

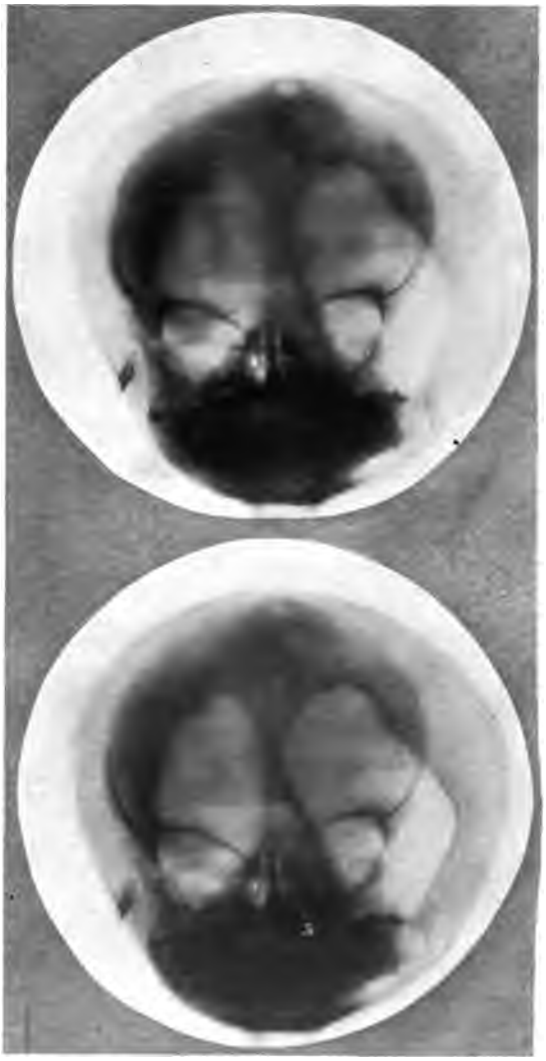


FIG. 7.

Anteroposterior view of Fig. 6. Note the fairly equal distribution of air in the two ventricles. This is probably due to the more extensive communication due to the enlarged foramina of Monro.

A = third ventricle.

[2] Dandy and Blackfan: *Am. J. Dis. Child.*, 1914, Vol. VIII, p. 406; 1917, Vol. XIV, p. 424. Also *J. Am. M. Assoc.*, 1913, Vol. LXI, p. 2216.

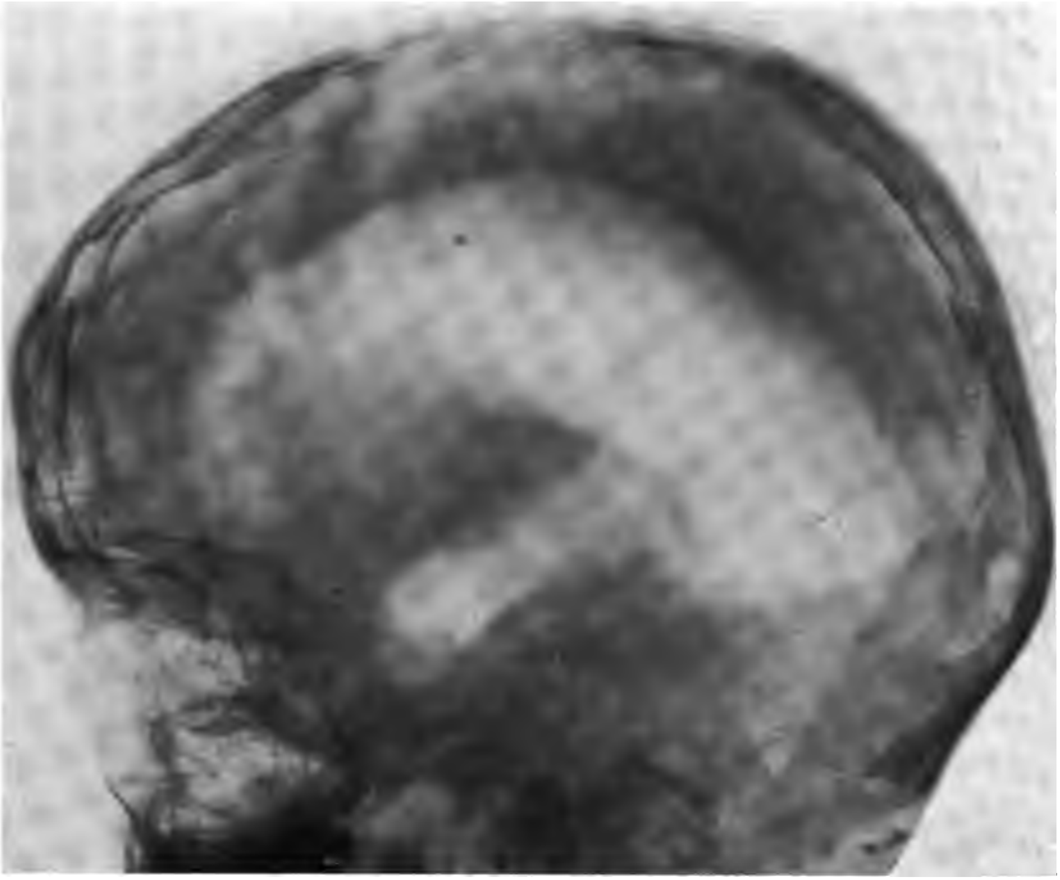


FIG. 8–A. Ventriculogram (lateral view) in a large head with closed sutures. The convolutional atrophy of the skull, indicative of internal hydrocephalus, is evident in the occipital and frontal regions. The markings are intensified by the air in the ventricles. III is third ventricle. The downward projection from the 3rd ventricle is probably the infundibulum. The patient was 12 years old; a large cerebellar tumor has been removed.

spinal fluid was clear and contained no organisms. The ventricular fluid was turbid and organisms were present; the ventriculogram demonstrated a greatly enlarged ventricle. The diagnosis of obstructive internal hydrocephalus, clinically unsuspected, was made with absolute certainty from the ventriculogram.

In two other children measurements of the head were normal but hydrocephalus was suspected because of abnormally large fontanels. In each case the ventriculogram demonstrated ventricles which nearly filled the cranial chamber (Fig. 5).

One of the most interesting diagnoses, made possible only through the ventriculogram, was in a colored child eight months old. The head was definitely larger than normal, indicating the probability of an internal hydrocephalus. Over the anterior fontanel, but slightly to one side, was a protruding tumor suggesting a meningocele, and this diagnosis had been made. Air injected into the lateral ventricle passed directly into the tumor. In the lateral ventriculogram the tumor was seen to arise from the greatly distended ventricle by a narrow neck (Fig. 6). An anteroposterior ventriculogram showed this communication to be unilateral. The diagnosis of a ruptured cortex with a (false) ventricular hernia was established, and subsequently verified at necropsy.

In another case a large cerebellar tumor

FIG. 8–B. (See description under 8–A.)

was removed from a boy 12 years old. The large head, the marked convolutional atrophy of the skull, blindness and the location of the tumor, made the diagnosis of internal hydrocephalus certain, but only the ventriculogram gave an accurate estimation of its advanced degree and the amount of brain destruction (Fig. 8).

Without a ventriculogram the diagnosis of internal hydrocephalus in children is frequently guess-work; with the ventriculogram the diagnosis is absolute.

We have as yet not obtained a normal ventriculogram. In one of these cases the ventricle was small, but not known to be normal. It is possible that one of the earliest signs of internal hydrocephalus may be alteration in the shape of the ventricle due to the pressure effects on parts of the wall which are least resistant. The obliteration of the angle between body and posterior horn in Fig. 5 (contrasted to Fig. 3) suggests this probability, but ventriculograms of the intervening stages and the normal are lacking.

We have not yet applied ventriculography to adults, but expect to do so in all cases in which the diagnosis is obscure. In a boy of 12 years the ventriculogram was even sharper than in younger children. In adults we should expect the ventriculogram to be at least as sharp, or possibly even more so because of the greater contrast between the density of air and bone. Several possibilities are anticipated from ventriculograms in adults: (1) The enlarged ventricles in internal hydrocephalus should be absolutely defined. (2) Tumors in either cerebral hemisphere may dislocate or compress the ventricle and in this way

localize the neoplasm. (3) Tumors growing into the ventricles may show a corresponding defect in the ventricular shadow. (4) A unilateral hydrocephalus may be demonstrable if the air cannot be made to enter the opposite ventricle.

CONCLUSIONS

1. The outlines of the lateral cerebral ventricles can be sharply outlined by the roentgen-ray if air is substituted for cerebrospinal fluid.

2. The injection of air into the ventricles has had no deleterious effects in twenty cases.

3. Ventriculography has already proved of great practical value in the diagnosis and localization of many intracranial conditions. It is invaluable in internal hydrocephalus.

AN IMPROVED DEVICE FOR THE ACCURATE LOCALIZATION OF FOREIGN BODIES BY MEANS OF THE ROENTGEN-RAY *†

BY S. C. BARROW, B.S., M.D.

SHREVEPORT, LA.

DURING the last few years so many devices for the localization of foreign bodies by means of the roentgen ray have appeared, and so many modifications of these, that it would appear there should be at least one among the many which would meet the essential requirements of mathematical and practical accuracy, simplicity and speed, as well as the great desideratum of mapping several points from which the surgeon may choose accurately his point of attack, instead of from the usual two points shown.

However, a careful study of these instruments as described in the publications I have seen, reveal to the practical roentgenologist that they fail to measure up to these essentials in full, particularly the one last mentioned.

The device illustrated in Fig. 1 and fully described below, is constructed on the parallax principle and under repeated rigid tests has proven absolutely accurate, rapid, simple and easy of manipulation.

DESCRIPTION OF APPARATUS

Referring to the illustration, we see that the localizer consists of the following parts: (a) hardwood base 8 by 12 inches by ¾-inch thick, through the center of which is a groove (f) which carries a sliding bar (e), in the right-hand end of which is a metal ring (y) which carries an ink pad; the upper surface of this bar is scaled to quarter inches (k), and the under surface is notched (l) which notches hold in any position placed.

On the left-hand end of the base (a) is a post (b) which is scaled to quarter inches and carries two sliding bars (c and d) which by double cuffs (gh and g'h') permits horizontal and perpendicular movement; each bar on its upper surface is scaled to quarter inches.

On the right-hand end of bar (c) is a small cross bar, in the center of which is a metal ring (x) through which an indelible mark may be made; on the ends of this small bar are two other small rings (ww), each of which is one inch from center of ring (x); to the left of this bar is a sliding bar (w'w') of same dimensions as bar (w w), the sliding cuff having an open center (z) through which the rays may pass.

Bar (d) has in its right-hand end a small metal ball (i); three bars (cde) are at all times in the same perpendicular plane.

* Read before The Texas Roentgen Ray Society, San Antonio, Texas, May, 1918. Reprinted from *Texas Medical Journal*, June, 1918.

† This article was first offered for publication in May, 1918. The editor was advised not to accept it on the ground that no further additions would be made to standard apparatus. Recently it was decided to add some of Dr. Barrow's suggestions to Blaine's apparatus. For this reason the article is published.

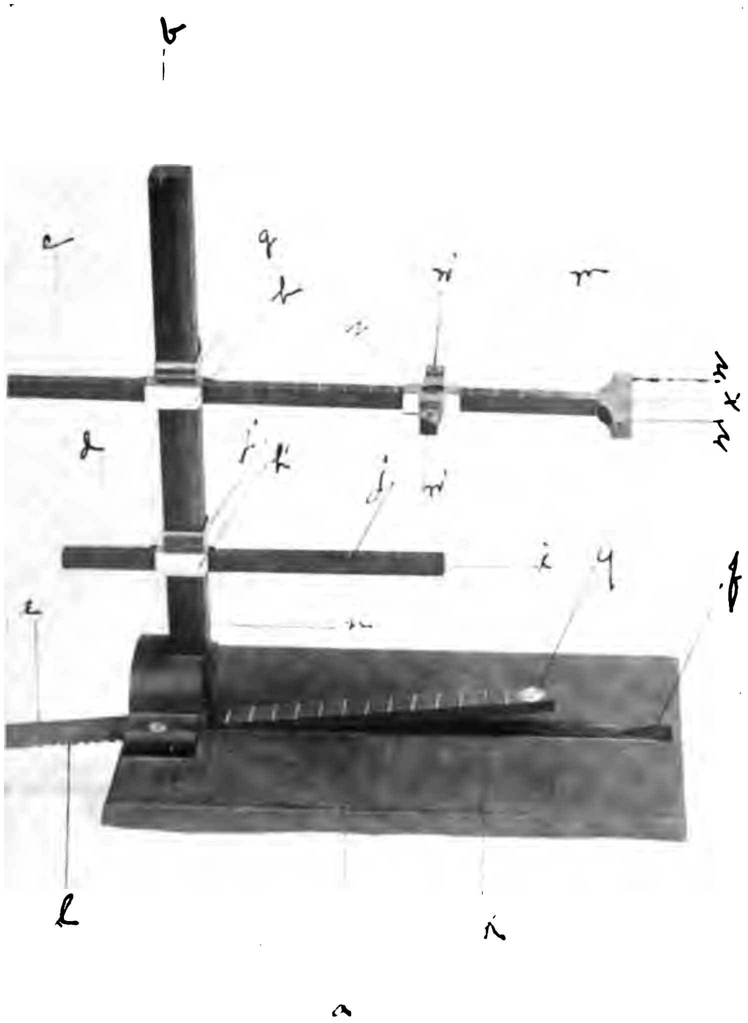


FIG. 1.

TECHNIC FOR USING THE LOCALIZER

In order to locate a foreign body it is necessary to have the usual horizontal roentgenoscope with sliding tube box and diaphragm. The patient is placed on the table and the localizer base (a) is slid beneath the patient and on top of the table, the bar (e) lying level in groove (f) while bar (w w) rests on upper surface of patient immediately beneath the fluorescing screen. The diaphragm being wide open and the room darkened, the tube is energized and foreign body in a general way located; the diaphragm is then closed down, allowing only a small beam of rays to pass, when the base of localizer and bars (c and e) are gently moved until the shadows of (y), (x) and foreign body are *accurately* superimposed. The diaphragm is then opened wide and the tube shifted so that the shadow of foreign body moves into that of (w) or (w); bar (d) is then pushed in until it touches the skin surface, and cross-bar (w′w′) likewise until shadow of (i) falls in shadow of circle (z); this accomplished, bar (d) is then raised or lowered until shadow of (i) moves into shadow (w′) in the same direction that shadow of foreign body was made to shift.

The lights are then turned on, screen removed, an indelible mark made at (i) and (x), while gentle pressure on left-hand end of (e) causes the ink pad at (y) to register its location, all of which can be accomplished without changing position of patient, which would endanger an accurate marking.

It is then only necessary to refer to the scales (m, n and k) to determine the distance of the foreign body below (x), above (y) and horizontally in from (i).

We thus see that we have made at once a localization which will enable the surgeon to remove the foreign body by any one of these three routes he may choose.

In addition to accuracy, simplicity and speed, this device carries with it the distinctive feature of giving three points of localization, all of which may be indelibly marked without changing position of patient from that in which he was at the moment of determining these points, thus eliminating a common source of error.

The model as illustrated, and with which we have carried out all our experiments, is constructed of hardwood in the main; aluminum may be substituted in its construction excepting for the base (a), which would be too thick if provision for groove (f) were made.

AEROPLANE SURGICAL UNIT

As mentioned in the Paris Letter, page 1155, a flying surgical unit has been devised by Nemirovsky and Tilmant. The specifications were filed with the Ministère des Inventions, Feb. 21, 1918. The success of the aeroplanes devised to carry the wounded to the surgeon soon suggested the advantages of conveying the surgeon to the wounded, and this "aerochir" is the result. It aims to bring to the first aid stations, to advanced posts without roentgen equipment, a well equipped surgical and roentgen outfit, and aid advanced posts overwhelmed by the influx of wounded beyond what they had been organized for.

The aerochir is designed to carry, beside the pilot, a surgeon and a roentgenologist to serve as assistant to the surgeon, with all the roentgen and surgical material for all kinds of interventions. The motor of the plane can supply the power for the roentgen current with the interposition of a small transformer and interrupter. It can serve also for electric sterilization, or a storage battery can be utilized for this. The apparatus are light and portable so that they can be readily carried into a first aid post or other surgical station and set to work at once, or they can be used in connection with the aerochir itself. The apparatus are not described in detail, but the advantages of a flying radiosurgical unit, alone or in squadrons, are emphasized, especially the rapidity with which surgical aid can be brought, the fact that the roads are left free just at the time when they are liable to be most clogged, the speed of transit and the fact that the wounded is spared the transportation, having aid brought to him in the swiftest and most complete manner. In urgent periods the aeroplane could return to headquarters for a new outfit, so that one or two of these aerochirs could serve for 200 kilometers of the fighting front, and no spot would be more than two hours away when summoned by telephone. The radioscopic and radiologic manipulations not requiring the patient to be undressed could be done in the aeroplane itself. With the cap devised by Dr. Mondain to be used with Nemirovsky's compass, the projectiles can be located in full daylight. This compass as well as any surgical instrument needed can be placed in the aeroplane without cumbering it.—*Jour. Am. M. Ass.*, Nov., 1918. "Current Medical Literature."

THE PRACTICAL USE OF THE WHEATSTONE STEREOSCOPE

BY H. CLYDE SNOOK, A.M., M.S.

NEW YORK

THE Wheatstone Stereoscope consists essentially of three things: a pair of view boxes to illuminate the stereoscopic pair of plates; a pair of mirrors mounted at right angles to each other for viewing the plates; and an optical bench, or a support, for the mirrors and the view boxes, on which they may be adjusted in mechanical relation with respect to each other. Stereoscopic vision is obtained by the right eye of the observer seeing one plate alone and the left eye of the observer seeing the other plate alone, and having the lines of vision converge from the eyes of the observer toward a point back of the mirrors where the two virtual images of the two plates occupy practically identical positions so that they may blend and repeat for the observer the conditions of ordinary normal vision of a similar real object. The brain makes out of these two virtual images a product which results in stereoscopic or normal vision of a solid object if the other necessary conditions regarding the making of the plates and the placing of them in the stereoscope are fulfilled. (See Fig. 1.)

In order that the observer may see the object on the plates, it is obvious that the relation of the eyes of the observer to the plates must be such that the field of vision is confined to the plates and that the plates include all portions of the object to be viewed. (See Figs. 2 and 3.) Since the distance between the centers of the pupils of the eyes of the average individual is two and one-half inches, it is obvious that a symmetrical position of the eyes, with respect to the plate, requires that each eye should lie in a vertical plane which passes through the center of the plate and that each eye should be one and one-fourth inches away from a perpendicular passing through the center of the plate.

In order that the x-ray tube may see the object as we wish the eyes of the observer to see it, we must arrange two positions of the focus spot of the x-ray tube in exactly the same relation to the plate as that sustained by the eyes of the observer. (See Fig. 4.) This gives us a distance of two and one-half inches between the two positions of the focus spot of the

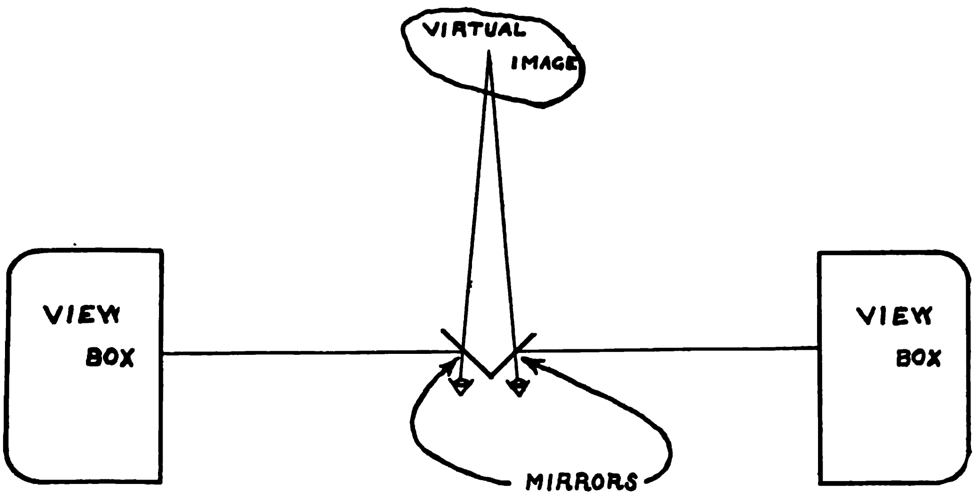


FIG. 1.

tube; that is to say, between the two exposures which must be made, we must have a straight line distance of two and one-half inches. *It makes no difference* whether we move the x-ray tube in an arc of a circle, in a straight line, or in any other curve which we may desire to use to accommodate the mechanism of our x-ray tube holder, *so long as the final result is a horizontal distance of two and one-half inches between the two positions of the focus spots at the times of the two exposures.*

The perpendicular points let fall upon the plate from the focus spots are called the "foot points," being the feet of the perpendicular lines drawn from the focus spots to the plate. These "foot points" are the important things with respect to the identity of the plates of the stereoscopic pair. In order to obtain the maximum benefit of the field of vision it is still obvious that the focus spots should be symmetrically placed about the center of the plate with a distance of one and one-fourth inches from each of the focus spots to the perpendicular let fall upon the center of the plate.

Since we must have two plates in the stereoscopic pair—one for the right eye

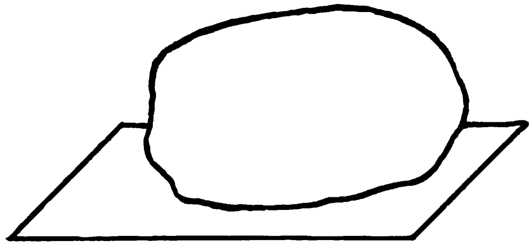


FIG. 2.

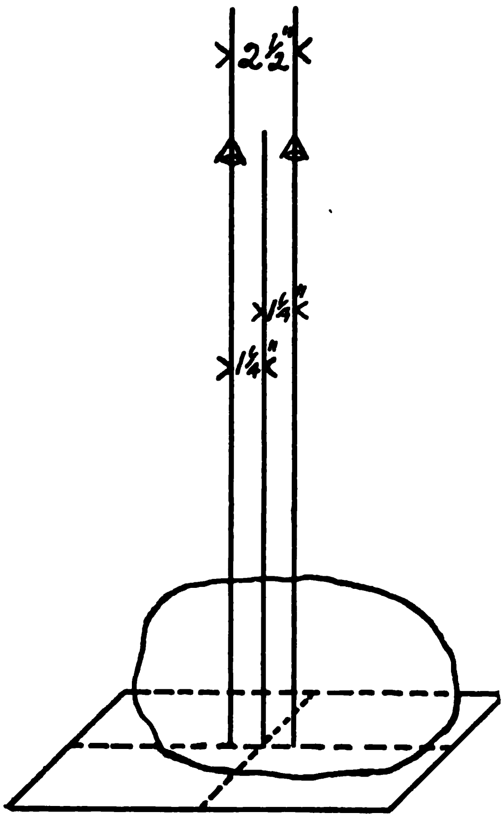


FIG. 3.

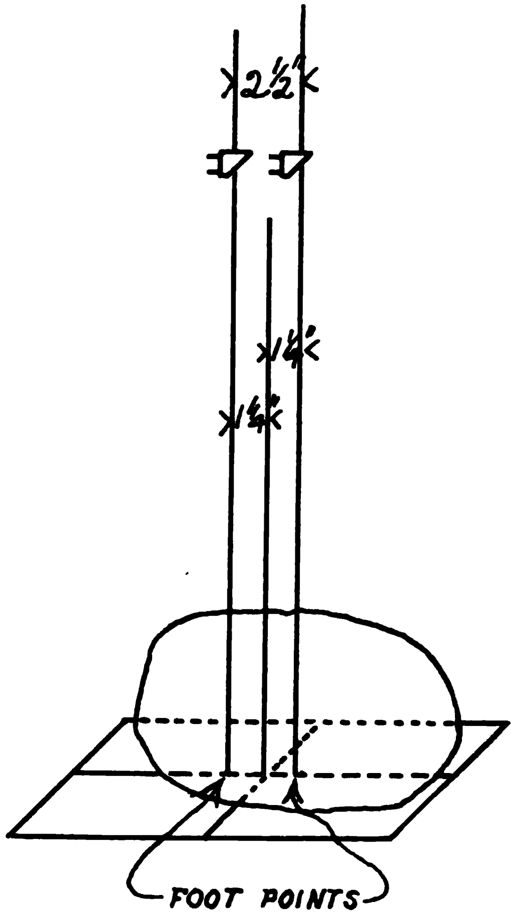


FIG. 4.

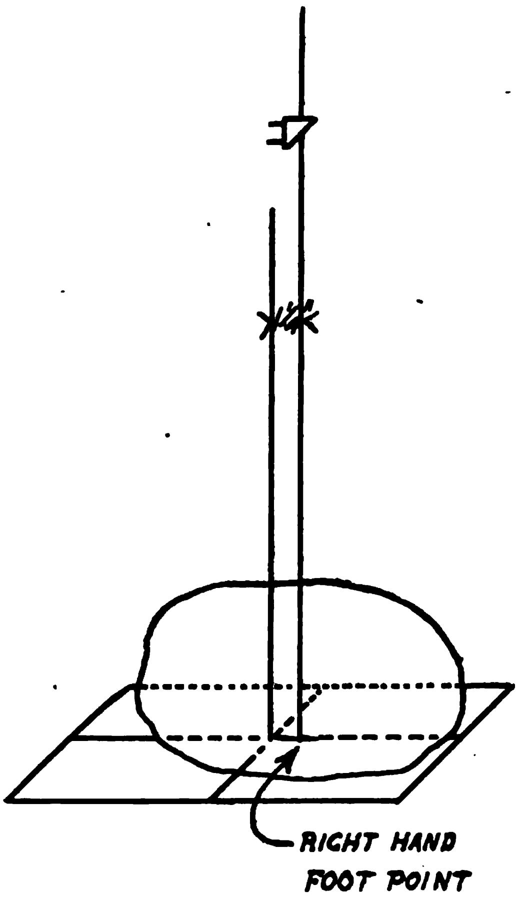


FIG. 5.

to see and the other for the left eye to see—we will have one plate with a right-hand foot point (see Fig. 5), and we will have another plate with a left-hand foot point. (See Fig. 6.)

Images of the object upon the plates do not ordinarily reveal the position nor the identity of either the right-hand foot point or the left-hand foot point; we therefore must devise a method whereby these foot points may be distinguished. (See Figs. 7 and 8. A slight shifting of entire image to right and left is the only difference usually distinguishable.)

In the diagram No. 9, let us assume that an object A-B capable of casting a shadow rests upon the photographic plate in a perpendicular position. It is seen that the rays, radiating from the focus spot upon the plate, will cast a shadow B-C of this vertical object A-B. Since all the points in the line B-C are necessarily in line with both the focus spot and the points along the line A-B, and since A-B being perpendicular must be parallel to a perpendicular let fall upon the plate from the focus spot, the shadow B-C must point towards the foot point. It is seen from these conditions that it makes no difference where on the photographic plate we may place the vertical object A-B, its shadow B-C, if prolonged, will pass through the foot point in every instance. (See Fig. 10 for another position of A-B.) Since the prolongation of B-C passes through the foot point, from one shadow alone we merely know that the foot point itself lies somewhere in the prolongation of the shadow B-C.

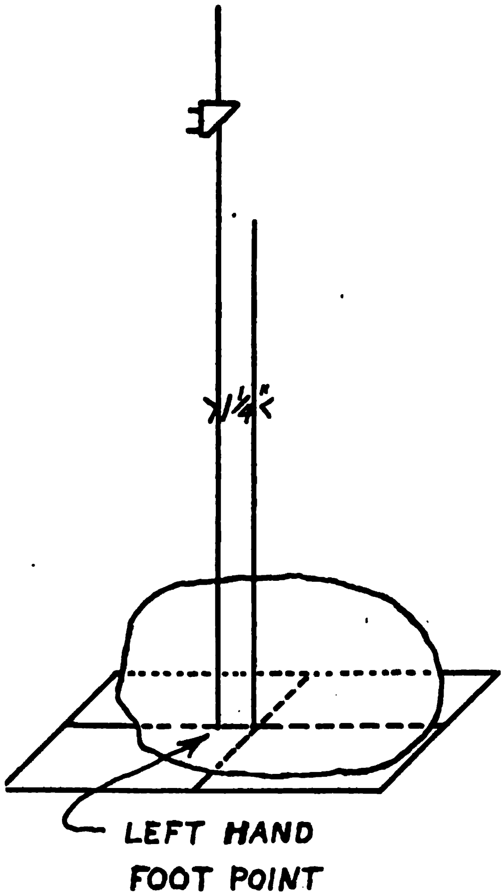


FIG. 6.

Should we have two vertical objects and should we produce their x-ray images and then draw their prolongations upon the finished x-ray plate, we would find the foot point at the intersection of these two prolongations since the foot point lies in each of them and can lie only at their common point—their intersection. (See Fig. 11.)

It is an easy matter, having obtained these two diagonal shadows of the two vertical objects with a lead pencil, to draw their prolongations upon the dried emulsion of the photographic plate and find their intersection—the location of the foot point. (See Figs. 12 and 13.)

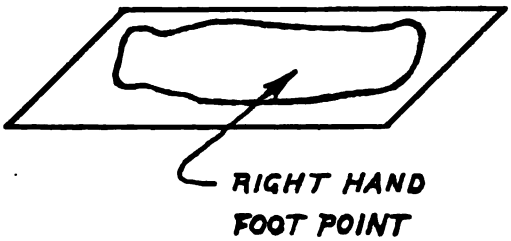


Fig. 7.

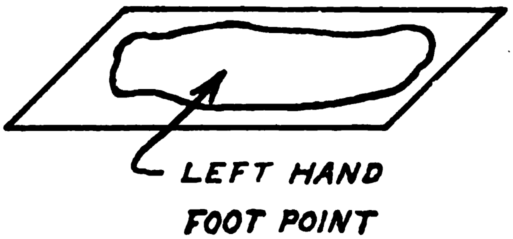


Fig. 8.

A convenient method for obtaining these diagonal shadows is to use two small wood blocks—each of them approximately a one-inch cube, to have driven vertically through the center of each of them a slender iron nail—and to place each of these two little blocks on an adjacent corner of the area on the upper surface of the tunnel or plate changer, so that their shadows will fall upon the corners of the plate where they will not greatly interfere with the area of the object under examination. This is a very simple method and requires no complicated apparatus. (Fig 13 locates a right-hand foot point and Fig. 14 locates a left-hand foot point.)

A still simpler method is to use only one wood block with its nail driven perpendicularly through it. This is feasible since it is not necessary to know the exact position of the foot points. *What we merely wish to know is whether the foot point is a right-hand or a left-hand foot point.* An examination of actual plates with the images of these vertical iron nails, or a little thought given to the geometry of the shadows, will convince any one that the shadow of the nail on the plate with the right-hand foot point will be shorter or longer than the shadow of the nail on the plate with the left-hand foot point, depending on whether the wood block with the nail has been placed at the right end of the plate or at the left end of the plate.

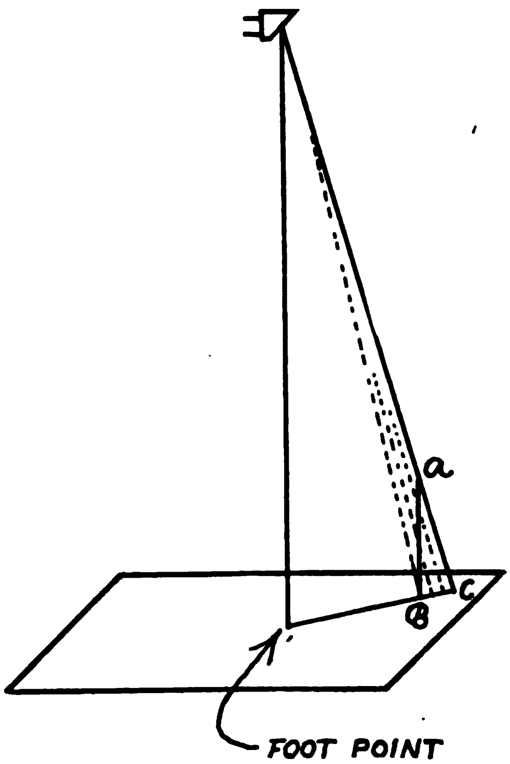


Fig. 9.

If the operator forms the habit of right-handedness and places the wood block with its nail at the right end of the plate in the lower right-hand corner, he can dispense with the second wood block with its nail. Of course, if he forms the habit of left-handedness and follows through a similar reasoning he can dispense with the second wood block in a converse manner. However, with the wood block and its nail at the right end of the plate, conveniently in the lower right-hand corner, the shadow of the nail on the plate with the right-hand foot point will be shorter than the shadow of the nail on the plate with the left-hand foot point. (See Fig. 15.) This can be remembered very conveniently. A short shadow indicating a foot point near to the shadow, is a right-hand foot point. The other plate, having a longer shadow, has its foot point farther away from the shadow of the nail—it is farther away toward the left—and is, therefore, a left-hand foot point. (See Fig. 16.)

The determination then as to whether the foot point is a right- or left-hand one resolves itself simply into determining which of the two shadows of the nails is the longer; this is a very simple thing.

The optical conditions for correct stereoscopic vision include the necessity of the right eye looking at an image with a right-hand foot point and looking at this image with the right-hand foot point in the correct right-hand position with respect to the right eye. Conversely, the left eye of the observer should look down upon an image with a left-hand foot point.

It is well known that the virtual image seen in a mirror is reversed horizontally with respect to the real object itself so that it is a right-hand-left-hand reversal which one sees in a mirror. That is to say, the plate of a chest would have the heart on the right side of the patient as one sees the plate in a mirror instead of with the heart on the left as it is in the living subject. Also, if in the ordinary way we look in a mirror at a plate of a patient's right hand, the image seen in the mirror would appear to be the patient's left hand. Therefore, since the mirrors in the stereoscope give us a right-hand-left-hand reversal of the plates under examination we must put the plates in the view boxes in such a position that the observer will look down upon a right-hand foot point

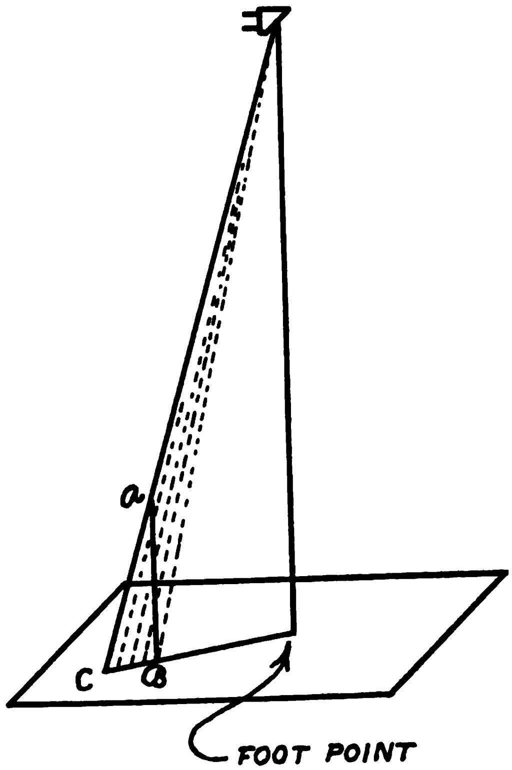


FIG. 10.

with the right eye and will look down upon a left-hand foot point with the left eye.

When the plates are right side up, that is to say with the patient standing on his feet and not upon his head, there is only one position of the plates which is correct that does not give either one or both of these two errors; the one error is a right-hand-left-hand reversal of the patient, putting the heart on the patient's right side, making a left hand out of a patient's right hand, making a left kidney out of a right kidney, or a left knee out of a right

knee, etc.; the other error is a distortion of all of the object excepting that portion in direct contact with the x-ray plate, so distorted that in some cases the size of the parts is enlarged fifty per cent. beyond normal and at an angle of forty-five degrees from their true position, such as with the clavicle bone inserted between the first and second ribs, with one frontal sinus twenty-five per cent. larger than the other, or one lobe of the lung all distorted, etc.

This one correct way of viewing the plates right side up requires that they should be placed in the view boxes of the Wheatstone Stereoscope with their glass sides "out," with the "foot points" towards the back of the stereoscope, with the "eye-plate distance" the same as the "focal-plate distance," and with the lines of movement of the x-ray tube between exposures on each plate horizontally parallel to each other.

If we should put the plates in the stereoscope right side up, with the foot points toward the back and with the emulsion side out, we would have a left-handed patient but no distortion. The image would suffer a right-hand-left-hand reversal and the view would be from the front as the x-ray tube saw it.

If, however, with the plates right side up we should put the foot points to the front of the stereoscope with the glass sides out, we would have a distorted view of the object from below; the top would be enlarged from twenty-five to fifty per cent., and there would be a right-hand-left-hand reversal of the patient as viewed from below or behind. If we should put the plates in the stereoscope right side up with the foot points to the front and with the emulsion side out, we would have a distorted view of the patient from below or from the back with the front of the patient enlarged twenty-five to fifty per cent., but there would be no right-hand-left-hand reversal of the patient as viewed from below or from the back.

If, now, we should put the plates in the view boxes upside down, with the foot points toward the back and the glass sides out, we would have a correct front view of the object or the patient with no distortion nor right-hand-left-hand reversal—the patient would simply be upside down. Should we place the plates in the view boxes upside down with the foot points toward the back and the emulsion sides out, we would obtain a front view of the patient upside down with no distortion but with a right-hand-left-hand reversal. Should we put the plates in the stereoscope upside down with the foot points to the front and the glass sides out, not only would the patient be upside down but we would have a distorted view of the patient from below or behind, and with a right-hand-left-hand reversal. If the plates be put in the view boxes upside down with the foot points to the front and the emulsion side out, the patient would be upside down; there would be a distorted view or an

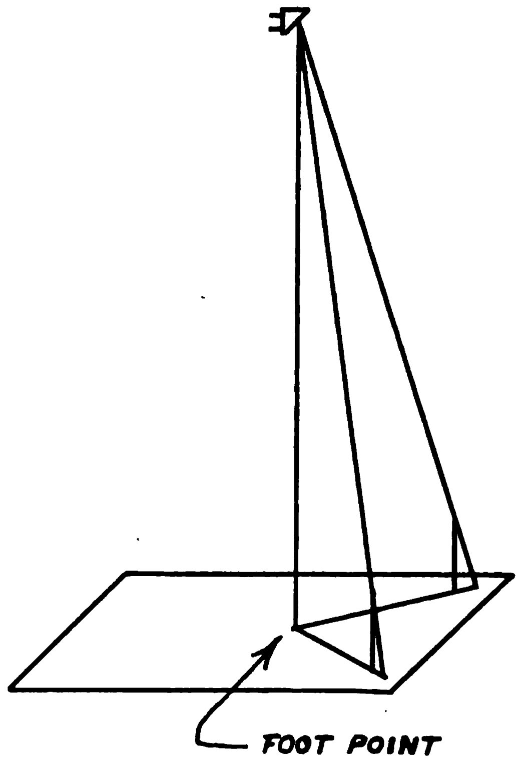


FIG. 11.

enlargement of the anterior portions of the object of twenty-five to fifty per cent.; we would be viewing the patient from below or from behind; but there would be no right-hand-left-hand reversal as viewed from below or behind. These results may be verified easily by making suitable stereoscopic roentgenograms of wood cubes.

It is thus seen that there are exactly eight ways of placing the stereoscopic pair of plates in the stereoscope; only two of them may be said to be correct without either distortion or reversals; and only one of the two gives a correct view of the patient right side up. To repeat, *the conditions of correct vision for the patient right side up require that the two plates be placed in the view boxes of the Wheatstone Stereoscope with their glass sides "out," with the "foot points" towards the back of the stereoscope, with the "eye-plate distance" the same as the "focal-plate distance," and with the lines of movement of the x-ray tube between exposures on each plate horizontally parallel to each other.*

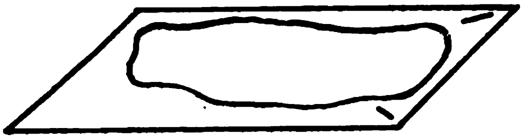


FIG. 12.

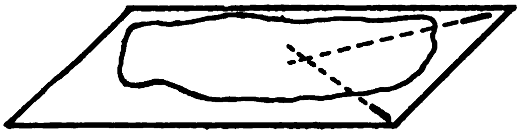


FIG. 13.

This one correct way of viewing the plates is not only the one correct way but also the easiest way to view the plates. The distortion produced by some of the other ways of viewing them causes a distinct eye strain and in many cases prevents the unaccustomed observer from getting any satisfactory stereoscopic vision at all. The other incorrect ways of viewing the plates which do not give distortion or eye strain give the obviously misleading views having right-hand-left-hand reversal leading to difficulties and errors in interpretation.

It should be noted that whenever the eye-plate distance is greater than the focal-plate distance the apparent thickness or height of the object looked down upon by the observer is greater than normal; conversely, if the eye-plate distance is less than the focal-plate distance the apparent thickness is less than normal. These errors in thickness either as to apparent increase or decrease of thickness may amount to an error of as much as fifty per cent. in some cases. If the eyes of the observer opposing the mirrors be higher in position than their obviously correct position opposite the mirrors in line with the foot points, the image of the object will be bent up from its true position; conversely, if the eyes are lower down than their correct

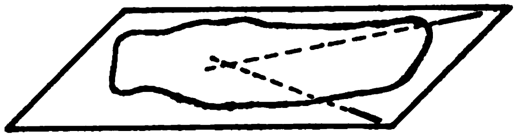
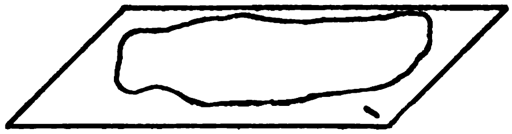
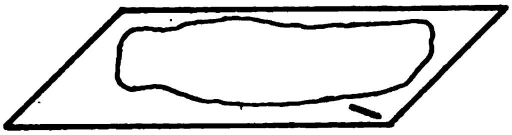


FIG. 14.



RIGHT HAND
FOOT POINT

FIG. 15.



LEFT HAND
FOOT POINT

FIG. 16.

position in line opposite to the foot points, the image will be bent downwards. The observer can easily demonstrate to himself the error introduced by incorrect position of the eyes by moving the head in circular motion—the circular motion in a vertical plane in front of the mirrors of the stereoscope—and he will immediately observe that the top of the object is following the movements of his head, bending towards the observer's head at all times.

In order to put the lines of movement of the *x*-ray tube between exposures in a horizontal position in the stereoscope, and in order to put the eyes of the observer opposite the virtual images of the foot points, there are three adjustments which are desirable. The first adjustment is the movement of the mirror carriage back and forth away from and towards the observer. This adjustment causes the two virtual images of the plates to move bodily to the right or to the left with respect to each other, enabling the observer to superimpose the one upon the other with respect to this horizontal adjustment. The second adjustment is the raising or lowering of the plates in the view boxes, the raising or lowering of the view boxes themselves, or the rotation of the observer's head in a vertical plane, raising or lowering the one eye with respect to the other. This adjustment moves the two virtual images vertically with respect to each other, permitting the observer to superimpose the one upon the other with respect to this vertical movement. The third adjustment is the tilting of the mirror carriage in a vertical plane at right angles to the line of the optical bench, or the rotating of the plates in a vertical plane in the view boxes. This adjustment enables the observer to rotate the two virtual images simultaneously about their own centers so as to obtain superimposition of this kind.

Occasionally, there is difficulty in observation due to the double images caused by the thickness of the glass in the mirrors. When this is troublesome the only recourse open to the observer is to train himself to direct his attention upon and concentrate his observation upon the desired image. There is no method of observation ena-

Position of Plates on Stereoscope.			Resulting Stereoscopic View.							
			Right Side Up	Front	Undistorted	No Right-Hand-Left-Hand Reversal	Up-side Down	Back	Distorted	R-Hand-L-Hand Reversal
Right Side Up	Foot Points Back	Glass Side Out	x	x	x	x				
		Emulsion Side Out	x	x	x					x
	Foot Points Front	Glass Side Out	x					x	x	x
		Emulsion Side Out	x			x		x	x	
Up Side Down	Foot Points Back	Glass Side Out		x	x	x	x			
		Emulsion Side Out		x	x		x			x
	Foot Points Front	Glass Side Out					x	x	x	x
		Emulsion Side Out				x	x	x	x	

bling one to overcome this difficulty. It is inherent in the design.

If one eye of the observer is somewhat less acute or weaker than the other, sometimes a change in the intensity of the illumination of the one view box as compared with the other will be of help, enabling the weaker eye to obtain a stronger image.

It is obvious that one should strive for plates of uniform density. This requires that the exposures be as nearly identical as possible, and that the plates should be developed, fixed, and dried together—that is, they should go into the developer simultaneously, come out of it simultaneously, and go through the whole photographic process subjected to identical conditions.

Another practical point often neglected is the desirability of cleaning off from the glass or the back side of the plates, the dissolved gelatin which has dried upon the glass. This can be accomplished quite readily by rubbing these spots with a damp towel. The towel should be merely damp and not dripping wet, as there is danger of getting drops of water on the emulsion side of the plate. Since there is decided loss in detail due to secondary radiation from the object itself and from the parallax or enlargement of the portions of the object nearest the x-ray tube, it is necessary that absolute fixation of the parts should be obtained so as to prevent further loss of detail. Movement of the parts between exposures will result in an incorrect stereoscopic view. Movement during an exposure causes loss of detail in that one exposure, and loss of stereoscopic detail.

In making stereoscopic pairs one should have the focus-plate distance as great as is practicable to get good plates, because stereoscopic vision is best and detail is clearest under these conditions.

It is often of help to make a mixture of barium sulphate with tincture of green soap, to spread it upon a gauze bandage just as thinly as possible (so as to have the structure of the gauze stand out in detail on the plate), and to wind this smeared bandage around the part. This will give a stereoscopic outline of the skin. Where the skin itself is full of detail, such as the palm of the hand, the mixture of barium sulphate and soap may simply be smeared on the skin itself. To localize an orifice or a lesion, it is sometimes desirable to use a small strip or cross of tinfoil held in place with adhesive plaster.

In conclusion, it is emphasized that many men are failing to obtain satisfaction in their stereoscopic work because of the uncomfortable and unsatisfactory vision which they obtain due to incorrect procedure at some point in the series of steps necessary to obtain correct stereoscopic vision. It is hoped that the simple methods here described will be of assistance in making this work more comfortable and satisfactory.

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THE BARDEEN METHOD OF ESTIMATING HEART VOLUME

Size is the fundamental factor in the roentgen examination of the heart. The clinical method is to define heart borders by percussion and to locate the apex beat by palpation. The roentgen method of outlining the heart and locating the apex is incontestably superior. The result by either method leaves much to the judgment of the examiner as to whether or not the heart in question is enlarged, considering the size, sex and condition of the patient. No tables are to be found in works on diagnosis which give us the normal heart volume for height, weight, age and sex. This is doubtless because there existed previously no method of precision for estimating cardiac size.

Now, however, we have in the Bardeen[1] method an accurate means of estimating heart volume and heart weight for either sex from infancy to old age. Bardeen's papers on this subject are models of scientific method. The first publication is to be found in THE AMERICAN JOURNAL OF ROENTGENOLOGY, December, 1917. The second article appeared in the *American Journal of Anatomy*, March, 1918. It is in this second paper that full details are given of his investigations, experiments and deductions. Much of the work was done in the postmortem room, but the volume of roentgen-ray work in the living is ample and his roentgen-ray technic is beyond criticism. A full consideration of the literature of the subject is included. Bardeen's researches have provided us with tables of normal values whereby our findings in any particular case may be compared.

Briefly, the method consists in estimating the square area of the parallel-ray silhouette of the heart upon the roentgen-ray plate. The square area is found by means of the planimeter—an engineering instrument which automatically computes any area, however irregular, by simply carrying the pointer around the outline. In the case of the heart the outline on the plate must be completed from left to right auricle and again from apex across the upper border of the liver to the right auricle. Bardeen's postmortem studies, in which he has shown great ingenuity, demonstrate that this can be done with a very

[1] This table will be found on pages 414-415-416 of the U. S. Army X-Ray Manual. A reprint will be sent on application to the publisher of THE AMERICAN JOURNAL OF ROENTGENOLOGY.

small margin of error. This is the only part of the Bardeen method where the personal equation is ineradicable.

The parallel-ray silhouette is obtained by a teteoroentgenogram taken at a distance of two meters. The patient sits with the front of his chest against the plate which is inclined to 20 degrees. Six per cent. is then subtracted from the square area to make the correction necessitated by the divergence of the roentgen-rays. The result is a figure ready for comparison with the tables. The volume and weight of the heart in diastole is thus found in its relation to the normal.

Bardeen's studies regarding the variations of heart volume in different positions of the body are of no less value to the clinician than to the roentgenologist. Roentgen-ray methods here as elsewhere are exacting a precision in purely clinical findings that was not attempted in pre-roentgen days. In the supine position of the body the heart is shown to be from 10 to 20 per cent. larger than in the standing. This change is due in part to changes in hydrostatic pressure in the inferior vena cava. Restricting venous capacity for storehousing blood by bandaging the legs materially reduces the difference. Bardeen selects the sitting posture for heart-size determinations because physiologic variations are minimized, and for the same reason clinicians should use the same position.

Bardeen took the heart in systole and diastole and studied the variations in size during inspiration and expiration. He selects full but not forced inspiration and a time exposure of not less than one and one-half seconds to ensure the diastolic silhouette.

Bardeen's work is a contribution of permanent value to medical literature and gives an added luster to American roentgenology. It marks a forward step in clinical methods. Henceforth the planimeter is a necessary part of a roentgenological equipment and the Bardeen tables are indispensable additions to the diagnostics of the heart. A. W. C.

The Dangers from Roentgen Therapy in Exophthalmic Goitre

Our attention has been called to an abstract, appearing in the December 7, 1918, issue of the *Journal of the American Medical Association*, (159) of a report by Secher (*Ugeskrift for Laeger*, Copenhagen, Oct. 10, 1918, Vol. 80, No. 41) of a death following the roentgen treatment of a case of exophthalmic goitre. He quotes Belot and Simon, among others, as stating that a correctly given course of roentgen treatment is free from danger, but takes issue with their statements. While roentgenologists who have had much experience in the treatment of this condition will agree that it is by no means free from danger, especially in careless and inexperienced hands, they can certainly lay claim to the fact that the danger in the hands of men of experience is far less than the surgical risks. The tone of this abstract and the conclusions of the author loudly proclaim lack of knowledge of the physiological action of roentgen rays, especially as applied to the treatment of exophthalmic goitre. It is doubtless true that the majority of internists and surgeons do not understand the basic principles of roentgenotherapy in any conditions, to say nothing of its action in this particular one. The author cites several cases in which an ordinary goitre has become transformed into the exophthalmie type under roentgen treatment. Now, it is a well-known fact among roentgenologists that the first action of roentgen applications, at least to deeper structures, may be stimulating, and in no condition is this effect so marked as is frequently observed following the first series of applications to an exophthalmic goitre. Roentgenologists are so well aware of this fact that they apply the first and often the second series with extreme caution. It is most likely that Secher's cases were already unrecognized exophthalmic types and not simple goitres, and that the beginning treatment stimulated secretion sufficiently to bring about the phenomena

of Graves' disease. On the other hand, it might be possible in the prolonged treatment of a simple goitre to bring about a condition of hypothyroidism. The author might do well to advise confining roentgenotherapy to exophthalmic goitre, and let the other types alone. Many internists and surgeons who do refer cases of Graves' disease for treatment are not fully cognizant of the fact that roentgenotherapy must be regarded as an adjunct to rest and possibly drug therapy, and that it is not a specific by itself. Failure to appreciate the necessity of enforced rest during early treatment may be fraught with grave danger. A frequent example of lack of knowledge of the action of roentgen rays in Graves' disease is the promise of the internist that the treatment will cause the glandular enlargement to disappear, whereas this is an effect which concerns the roentgenologist not in the least. In the case reported by Secher as having died we are unable to determine whether the patient died following a single series of exposures or after several, as the translator has not made this clear. The possibilities of untoward effects of early treatment and their avoidance have been referred to. It is of course quite possible to go too far with treatment and bring about a condition of hypothyroidism. Both extremes must be avoided as carefully as an overdose of a poisonous drug. A definite percentage of death rate has not deterred the surgeon, neither should a few reported deaths comprising a very much lower percentage act as a damper upon roentgenotherapy. Reference to another article by Nordentoft in the Aug. 29, 1918, issue of the same journal and abstracted in the *Journal of the American Medical Association*, Nov. 16, 1918 (110), will serve to cheer the roentgenologist, as quite another light is thrown on the subject.

In conclusion, let us try to teach our non-roentgenologic colleagues the physiologic action of the roentgen ray, its application to the treatment of exophthalmic goitre, and the necessity for properly handling cases in addition to this treatment.

H. K. PANCOAST,
RUSSELL H. BOGGS.

PACIFIC COAST ROENTGEN RAY SOCIETY

IN SPITE of the fact that eighteen of its twenty-six members are in service with the colors, a meeting of the Pacific Coast Roentgen Ray Society was held in San Francisco, on Saturday, December 21, 1918. All of the officers excepting the Vice-President, Dr. W. Warner Watkins, Phoenix, Ariz., were in France. The meeting was called primarily to hold the organization together and elect new officers for the coming year.

The meeting was necessarily small, but made up in enthusiasm what it lacked in numbers. Comprehensive plans were made for the year 1919, including a determination to send a large representation to the annual meeting of the American Roentgen Ray Society at Atlantic City. The officers for the ensuing year are as follows:

President: Dr. W. W. Boardman, San Francisco. Vice-President: Dr. Chas. M. Richards, San Jose. Secretary and Treasurer: Dr. Wm. B. Bowman, Los Angeles. Corresponding Secretary: Dr. W. W. Watkins, Phoenix, Ariz. Executive Committee: Drs. Albert Soiland, Lloyd Bryan and Lyell C. Kinney.

C. M. RICHARDS—SEC'Y.

TRANSLATIONS & ABSTRACTS

Salmond, R. W. A. A Technique for the Lateral View of the Upper End of the Femur. (*Arch. Radiol. & Electroth.*, 1918, Vol. XXII, p. 297.)

"The patient lies on the couch in the lateral position, is then securely immobilized by sand bags above and below the knee and across the foot. The patient is next asked to let his body and the lower limb, which is free, swing gently backward; in so doing it will be found that the femur of the immobilized limb does not take part in the movement. What really happens is that the pelvis rotates around the head of the fixed femur and the opposite limb is thus got out of the way. Sand bags or pillows are now placed under the patient's chest and back and around the free limb, to make him comfortable and to keep his whole body at rest. The tube overhead and parallel to the plate and table is then centered over the head of the femur and the exposure made. The extension tube can be brought down to the surface of the skin without interference with the opposite thigh or side of the pelvis. Stereoscopic views can also be taken in this position.

"The result is a true lateral view of the outline of the head, neck and trochanters of the femur, though not, of course, of the pelvis as it has rotated. Because of this, the view cannot be properly described as a lateral one of the hip-joint. As a test that a true lateral view has been obtained, the posterior dense margin of the femoral shaft should be seen running up to and becoming continuous with the outline of the lesser trochanter, and should not be seen running independently across its base."

Brown, Alexander G. Oral Sepsis and the Cardio-Vascular System. (*South. M. J., Nashville*, Vol. XI, Sept., 1918, p. 601.)

Experimental evidence pointing to the relation of the tonsil infection in the human to heart infection in the animal made the subject of investigation. Causal relation was shown between infection of foci from infected tonsils, pyorrheal pockets, parotid glands, rheumatic fever, and arthritis, endocarditis, pericarditis, and myocarditis. The relation of chronic foci to systemic disease has been demonstrated experimentally.

Clinical evidence shows a cause and effect relation between oral sepsis and heart diseases. The etiologic relation between oral sepsis and arthritis has also been pointed out. Other clinical and therapeutic evidence points to the same conclusion. "In young patients with signs of recurrent endocardial lesions, showing intermittent fever, a low state of vitality, anemia, and under-development, the removal of chronic tonsillar or other oral, nasal, or aural infections, is followed by improvement in strength, growth, and cardiac function. Likewise in adult or aged patients with cardiac weakness (myocarditis), chronic arthritis, general muscular weakness, nephritis, the removal of oral septic foci (pyorrheal abscesses, sinus, or antral infections) is attended by steady improvement in the heart action itself."

Conclusions from the study of evidence, and evidence collected from private personal practice are: Focal infection of the mouth (chronic alveolar abscess, chronic pericementitis, acute and chronic infection of tonsils and other oral, nasal, and aural cavities adjacent) produce serious, dangerous diseases of the heart,—endocarditis, myocarditis, pericarditis, or pancarditis. Disease of important organs of the body must diminish as the profession instructs the laity that the care of the human mouth from focal infection or the early eradication of oral infection when present, is an insurance against many systemic maladies. Thorough mouth inspection should be made on every new patient coming for treatment or diagnosis. Old patients with recurrent diseases should receive careful and painstaking mouth, nasal, and aural inspection, searching for any possible storage of septic bacteria. Dentists must be impressed with the importance of complete and accurate removal of every focus of primary infection, or else secondary metastases can not be improved or cured. Roentgen ray is necessary for detecting foci in roots of teeth, whether crowned or not, in the bone of the lower jaw; but the evidence of gum infection, tonsillar infection, or salivary infection, must be determined by inspection and study by the diagnostician.

Pfender, Charles A., M.D., Washington, D.C. Tuberculous Lymphatic Glands of the Neck Treated by Roentgen Therapy.

The author divides cervical adenitis into three groups: inflammatory, suppurative and sinus cases.

The inflammatory cases, whether large or small, uniformly respond to roentgen treatment, provided any existing trouble in teeth, tonsils or nose is also eliminated. Surgery is contraindicated in these cases.

In suppurative glands a combination of surgery and roentgenotherapy is indicated. The author removes the pus by aspiration instead of incision and then injects the abscess cavity with iodol or creosoted iodoformic oil. After this the roentgenotherapy is instituted.

In sinus or fistulous cases drainage is made as free as possible and the skin is dissected loose about the mouth of the sinus. After this, intensive radiation promptly heals the fistulous tracts.

The author uses the cross-fire method and applies 10 X to 15 X Kienboeck filtered through three to four millimeters of aluminum and three millimeters of leather to each area, and repeats the treatment in from two to four weeks. If the bronchial glands are involved, constitutional effects will be observed unless the dose is reduced to 10 X Kienboeck units. After citing the opinions of some 30 odd authors in reference to roentgen treatments of tuberculous-glands and giving case reports of 10 very interesting cases the author concludes:

1. Roentgenotherapy offers the best results of all the remedial measures now known for the treatment of acute, subacute, and chronic forms of tuberculous cervical glands, both hyperplastic and suppurative.

2. Simple hyperplastic tuberculous glands of the neck should not be treated surgically until roentgenization has been tried. Only when the latter fails is an operation to be considered.

3. Suppurative tuberculous cervical adenitis is best treated by simple incision or evacuation by aspiration, preceded and followed by roentgenization.

4. Suppurative glands with discharging sinuses give the highest percentage of cures when treated by surgical drainage combined with roentgenotherapy. Repeated operated sinuses with failure to cure yield promptly to roentgenization.

5. The conservative treatment of tuberculous cervical glands comprises medicinal, dietetic, heliotherapeutic, and roentgenotherapeutic measures and is followed by ideal results. Surgical measures are merely auxiliary aids in selected cases.

6. Extensive dissection with excision of tuberculous cervical glands is now rarely, if ever, justified.

7. Contraindications to roentgenotherapy do not exist. Local and general improvement of the patient follows proper roentgenization in all varieties of tuberculous glands of the neck.

G. W. Grier.

Basch, Seymour. The Differential Diagnosis Between Chronic Gastric Ulcer and Carcinoma of the Stomach. (*N. York State J. M.*, Vol. XVIII, No. 11.)

The contention of the author is that the roentgen ray is not of value in the early diagnosis of cancer of the stomach. He says that its greatest value is in the diagnosis of the more advanced forms and the nature of existing complications. The size, form, position, fixity, tone, peristaltic activity, and relation to other organs, deformities, peristaltic breaks and so on, can be best diagnosed by the roentgen ray. The progress of the disease is also noted. Peristaltic breaks are best observed by screen and filling defects by plates.

Lichty, John A., M.D., Pittsburgh, Pa. The Incidence of Peptic Ulcer and Carcinoma in the Duodenum. (*N. York State J. M.*, Vol. XVIII, No. 11.)

The author observes that cancer of the duodenum was first described by Hamburger in 1746. Ulcer of the duodenum was first mentioned in 1817. Until about 25 years ago ulcer of the duodenum was not a popular diagnosis. Now it is the most frequently recognized lesion in the gastrointestinal canal. In a series of 808 cases of cancer of the intestine Nothnagel found only 4.5 per cent. in the duodenum; while statistics show that of cancers in general, only .34 per cent. occur in the duodenum.

In a series of 486 patients with duodenal lesions, six were found to have cancers. Of these six, the cancer in two was in the pyloric ring and in four at the papilla of Vater. Moynihan says that 90 per cent. of the ulcers are found in the

first inch and a half of the duodenum. Apparently then, cancer is not found in the same area as ulcer. He asks the following questions: "If carcinoma of the stomach so frequently arises from a peptic ulcer, why doesn't carcinoma occur more frequently in the duodenum where peptic ulcer abounds? Is it not probable that the etiological and determining factor of carcinoma of the stomach is something entirely independent of peptic ulcer?"

BARRINGER, BENJAMIN S., M.D. Surgery Vs. Radium in the Treatment of Carcinoma of the Bladder. (*N. York State J. M.*, Vol. XVIII, No. 11.)

The author states that there are two types of carcinoma of the bladder. First, the papillary type which projects into the bladder; second, the indurative type which extends through the bladder wall and thence outward. He considers the urinary bladder an unfavorable field for surgery on account of the difficulty of reaching the neck and the trigone where 80 per cent. of the tumors are found. The constant motion of the bladder is regarded as a hindrance to surgery as it interferes with the healing after the operation. He looks upon the bladder as a unique field for radium. The motion does not interfere with the action of the radium, and the urine acts as a filtration screen.

BOGGS, RUSSELL H. The Comparative Value of Radium and Roentgen Radiation. (*Pa. J. of Roentgenol.*)

When radium is placed in contact with the tissues it is effective only for a depth of about one inch. Deeper effect can only be produced by removing the radium to a distance and cross-firing. This is not practical, because the supply of radium is too limited to get large enough doses with the radium placed at a distance from the part to be treated. Therefore, in a general way, when a local action is desired radium is preferred, and when large areas are to be treated roentgen rays are preferred. Small doses are stimulating, large doses destructive, The latent period after application varies with the size of the dose; the larger the dose, the shorter the latent period. Gland cells are very sensitive to the action of the rays; cartilage is little affected. Endothelium of the small vessels is very sensitive and swells enormously under small doses, while larger doses destroy it completely. This susceptibility is greater toward radium than toward roentgen rays. Sarcomatous tissue in glands is more easily destroyed than metastatic carcinomatous glands. Tubercular adenitis responds more quickly than metastatic carcinoma, but not so quickly as sarcomatous glands, although the result in sarcoma is often only temporary. An epithelioma on a mucous membrane is more malignant than one on the skin and will require more treatment.

Carcinoma of the Uterus.—Up to the present radiotherapy has only been employed in inoperable or recurrent cases. After radium treatment the bleeding ceases, the offensive discharge increases and becomes odorless, the cancerous mass diminishes in size and sometimes entirely disappears. When the pain and discharge cease, the general health improves rapidly and the patient recovers for a time at least.

Technique.—Less than 50 milligrams should not be used, and within the first week or ten days from 2,000 to 4,000 milligram hours should be given. This may all be given at one time, or it may be divided up into six or eight doses. The result seems to be about the same. The roentgen rays should be applied externally at the same time.

Carcinoma of the Rectum.—Results are not nearly so satisfactory as in carcinoma of the uterus. A proctitis always follows treatment if large enough doses are given, and a colostomy is necessary to prevent irritation of the inflamed area.

Epithelioma.—When situated on mucous membranes, radium is better than roentgen rays. The virulence of an epithelioma depends on the richness of lymphatic supply at the region where it is located. The prognosis depends on the variety, extent, duration and rapidity of the process. Epitheliomas of the lower lip treated by radium with the roentgen ray applied to the glands, do better than by surgical treatment alone where the recurrences reach 50 to 75 per cent.

Sarcoma in the nasopharynx responds well to radium treatment. Carcinoma in the mouth and throat does not do as well under radium treatment as sarcoma, but some good results have been obtained. If the ulceration is confined to the mucous membrane it responds well,

but if muscle tissue is involved it is very resistant. In such cases electric coagulation following a full radium treatment is usually successful.

Carcinoma of the Breast.—Following operation, a full physiological dose should be given to the area involved and over all the lymphatic chains draining that area. These are the axillary, supra-scapular, anterior pectoral of opposite side, internal mammary, sub-scapular, paravertebral, xiphoid and inguinal groups. Metastasis occurs more quickly in the young and in the fat, on account of the richer lymphatic supply. Radiotherapy produces a sclerosis of the lymphatics and therefore retards metastasis.

G. W. Grier.

Hinman, Thomas P. Discussion—Symposium on Oral Sepsis. (*South. M. J., Nashville*, Vol. XI, Sept., 1918, p. 613.)

The question of what should be done with bad or dead teeth and how they should be handled is being worked out scientifically by the Research Institute of the National Dental Association. Every gold crown ought to be suspected. The day is coming when gold crowns will no longer be seen. The methods that have been used in filling root canals did not prevent infection but at present the methods used do prevent infection of canals.

Bailey, Harold. Radium in Uterine Cancer. (*Surg., Gynec., and Obst.*, June, 1918, Vol. XXVI, No. 6.)

. Although the radiotherapy of uterine cancer of the inoperable type is more than justified as it causes amelioration and often a standstill of the symptoms, the technic of its application in operable cases has been hazardous due to the lack of a clear understanding of the methods of standardization.

During a period of two and a half years at the Memorial Hospital, New York, the author has had under radiation at various times about 120 cases of uterine cancer and has improved the technic of the application in a marked degree. In 1915 the technic was the French method with massive dosage and the radium was applied by means of the usual applicator, consisting of a small lead capsule about 2½ mm. thick and 2½ cm. long.

Beside the uterine and vaginal application rectal treatments were also made and a combination of roentgen-ray treatments and radiotherapy was given in a number of cases with good results.

In 1916 a change in technic was made. Instead of the old lead filter a platinum filter was applied which caused less irritation of the surrounding organs. The capsule was inserted in the uterus and the cross-firing method abandoned. Repeated treatments with the radium applicator in the same place caused a local necrosis of the cervix, making necessary the use of an improved applicator. This consisted of a solid lead globe, 3½ cm. in diameter with the one pole removed and forming a receptacle for the platinum capsules. But even so the secondary rays from the lead globe caused considerable irritation to the neighboring parts and this led to the making of a further improved applicator, the "mercury bomb." In this, mercury was used as a filter—a thin capsule of iron, 3½ cm. in diameter, filled with mercury. The top of the capsule had a receptacle of lead wherein the platinum tubes were placed and all was covered with a rubber cap. At the lower end was fastened a wire for directing the apparatus. The thickness of the mercury at the projecting end was 1 cm. and behind, 2 cm.; and the rough measure of the ionization of the radium through 1 cm. of mercury was found to be 1 per cent. With this mercury bomb two objects were accomplished: cross-fire treatment from within the cervix and radiation for quite a distance into the pelvis. In the vaginal applications the bomb is directed toward the lesion on the cervix and later on towards the right and left parametria, held in position by strapping the wire-stem to the patient's thigh. Besides the vaginal treatment the lower abdomen also is treated with the same mass of emanation. Here the radium is placed in a wooden receptacle 4 cm. thick and lined and covered with a 3 mm. thickness of lead. It is the author's opinion that the initial dose must be high and not repeated over the same area. The cross-firing should be made use of from within and from the surface of the body. By using the mercury bomb the harmful effects from unfiltered rays are eliminated and the treatments should be completed as soon as possible so that the time of the second application will not coincide with the irritative effects of the first.

Peer Lund.

Clark, John G. The Therapeutic Use of Radium in Gynecology. (*Surg., Gynec., and Obst.*, June, 1918, Vol. XXVI, No. 6.)

In his article the author reviews his results of radiotherapy in two types of cases, the myopathic hemorrhages of benign origin near the climacteric, and cases of inoperable cancer of the cervix and vagina. He reports in all one hundred cases of each class, and draws the following conclusions.

In cases of benign uterine hemorrhages radiotherapy is found easily competing with the surgical procedures.

Radium was applied to women where no tumor was palpable, but dysmenorrhea was present. If a massive tumor was present, with resultant inflammatory conditions, an abdominal operation was always advised; and in young women, where a myomectomy is possible.

Radiotherapy is to be employed in fibroma patients of the following two classes: (1) To women with benign myopathic hemorrhages and in women over 40 years of age in whom it is desired to bring on the menopause. (2) In small doses to young women with excessive menses with very small myomata, and cases of polypoid endometritis.

Radium should not be employed when the tumor is larger than a three to five months gravid uterus; or in young women with a single easily removable myoma, where a premature menopause may be the result, if dosage is not carefully watched.

Technic of application: after curettage, radium, protected by platinum and rubber, is inserted in the fundus of the uterus, dosage being an average 50 mmllgr. for 24 hours. Success was obtained in all the cases but two, one of which was a chronic pelvic inflammation and the other a case of multiple myomata.

In cases of cancer of the cervix or vagina the radiotherapy is somewhat more uncertain, but in 52 per cent of the cases a local cure was effected; 60 per cent were relieved for the more or less profuse hemorrhages and in many cases the pain was checked.

If a case has been locally healed by radium it is contrary to his belief to attempt surgical interference.

It is always difficult to determine which cases are amenable to radium. While it is the treatment of choice in cancer of the cervix or vagina, hysterectomy is undoubtedly the correct procedure in cases of cancer of the fundus.

Peer Lund.

Price, W. A., and Pond, Samuel E. Electrolytic Medication. (*J. Nat. Dent. Ass.*, Vol. 5, Aug., 1918, p. 855.)

Evidence is given on (1) the direct action of electrolytes, electric current, and electro-chemical products upon bacteria—(2) whether or not the current reaches the tissues involved. It has been assumed by those using "Electrolytic Medication" that (a) electrolytes or ions, (b) electric current, and (c) the electrolytically precipitated elements killed bacteria. In the research, no evidence was found to support these views. It seems there is no *direct* action leading to disinfection under present practice. Further, the energy which had been believed to be expended on the pathological tissues about the apex, has been found to be expended on the normal pericemental tissues about the lateral root walls. If there is a beneficial action or disinfection, it must be indirect. It may be possible to perfect an electro-chemical method as an efficient agent for the sterilization of tooth and supporting tissues.

Byron C. Darling, M.D.

Merritt, Arthur H. The Pathology, Etiology, and Treatment of Pyorrhea. (*Dental Cosmos*, Vol. LX, July, 1918, p. 574.)

The pathology of pyorrhea alveolaris is described. There are two etiological factors: predisposing and exciting. Predisposing causes are systemic diseases, localized malnutrition due to lack of mastication, frail bony investment of the teeth, and occlusal trauma. Exciting causes are those which irritate the gingiva, exposing the tissues to infection. Uncleanliness of the mouth and faulty approximal contact-points cause this initial irritation. In treating pyorrhea, the etiological factors should be considered and corrected. Pyorrhea is a curable disease but patients affected may not always be cured. A most exacting technic is necessary. Treatment consists in correcting the occlusion and establishing normal nutrition in the investing tissues. In treatment, good root surgery is necessary. It has been asserted that "suppurative detachments of the peridental

membrane are permanent detachments." This is not true. Such a reattachment takes place as a rule in the hands of a skillful periodontist. The fact that reattachment never takes place about non-vital teeth that have become septic indicates that in some way, not understood, the pulp is the controlling factor in the vitality of the cementum. The absurdity of destroying the pulps in treatment of pyorrhea is apparent.

HARTZELL, THOMAS B. The Clinical Type of Arthritis Originating About the Teeth. (*J. Am. M. Ass.*, Vol. LXV, Sept. 25, 1915, p. 1093.)

In 220 patients studied, *streptococcus viridans* was found in the dental abscess and in the superficial tissues of the peridental membrane; this condition was associated with joint infection. Of twenty vital teeth extracted and examined, ten contained living pulp entirely germ free; the other ten offered growth of *streptococcus viridans*.

Arthritis of dental path origin is characterized by slow onset with exacerbations and remissions; these exacerbations seem coincident with the filling to distention of dental abscesses or retention of pus from deep pyorrhea pockets draining directly into the circulation.

Treatment of pyorrhea pockets by curettage and evacuation of dental abscesses has an effect like that of vaccine (inoculating the patient with a large number of organisms). By this treatment the supply from the focus is shut off. When many pyorrhea pockets or abscesses occur, it is important to permit from three to six days to intervene between treatments, which brings a constant gain generally ending in cure. If sudden complete extirpation of all foci, *e.g.* extraction of all the teeth at once is practiced, the end result will be positive harm.

Early elimination of foci in arthritis of dental origin renders it easy to control. If such foci are active for a considerable time, elimination of the foci, while limiting progress of the disease, will not repair it.

MYER, K. F. The Present Status of Dental Bacteriology. (*J. Nat. Dent. Ass.*, Vol. IV, Aug., 1917, p. 966.)

A full critical review is made of recent literature on the microbiology of the mouth under three heads:

(1) Bacteriology and protozoölogy of the mouth cavity.
(2) Microbiologic studies in relation to dental caries.
(3) Bacteriology of oral abscesses, chronic periosteitis, and osteitis dentalis, and their importance as foci of systemic diseases.
(4) The etiology of pyorrhea alveolaris from the viewpoint of recent bacteriologic and protozoölogic studies.

BYRON C. DARLING, M.D.

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STREPTOCOCCUS EMPYEMA*†

A STUDY OF THE CONDITION AS REVEALED BY THE ROENTGEN RAY

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THE unusual prevalence during the past year of empyema due to the streptococcus hemolyticus has done much to further our knowledge regarding the roentgen-ray diagnosis in diseases of the chest.

Starting, as a rule, with a local condition in the pharynx, the infection in these cases extends down the respiratory tract and invades the lungs, producing a condition varying from a simple bronchiolitis or peribronchiolitis to a broncho- or lobar

FIG. 1. PERSISTENT RIGID WALLED SINUS. NO INJECTION.

FIG. 2. OLD HEALED LEFT EMPYEMA. REMAINING PLEURAL THICKENING WITH PERICARDIAL ADHESIONS.

* Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Chattanooga, Tenn., September, 1918.
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pneumonia. It may or may not follow one of the acute infectious diseases, such as measles or mumps. There is a great tendency toward the formation of sub-pleural abscesses; many authorities claiming that

FIG. 3. OLD DRAINING RIGHT EMPYEMIC CAVITY IN THE MIDST OF EXTENSIVE PLEURITIC THICKENING.

the involvement of the pleura is secondary to the pulmonary lesion, and is probably caused by a rupture of one of these abscesses into the pleural cavity. The pleural effusion occurs very early, and is considerable in quantity: at first it is serous, but very soon becomes serofibrinous and, finally, frankly purulent. It appears during the course of the lung involvement and is not postpneumonic, as we are accustomed to see in the pneumococcus infection. The symptomatology, physical diagnosis, roentgen ray examination, and diagnostic aspirations, all come into play in making the diagnosis, and it is only by a complete correlation of the findings of these different diagnostic methods that we can hope to arrive at a correct conclusion.

The difficulties in many cases are that the subjective symptoms present much the same clinical picture with or without fluid, and the physical signs are equally deceptive. In these cases the roentgen-ray examination, in conjunction with aspiration, would be of material assistance in clearing the situation.

The experience of the writer has been limited to cases of from three to six months' standing, but he has every reason to believe that accumulations of fluid in the pleural cavity occur in this infection as in the postpneumonic cases, except that they are more rapid in formation. In a communication read before this Society at its annual meeting held in Chicago in 1916, attention was called to the fact that early pleural effusions appear in the axillary space, climbing up between the parietal and visceral pleura until the apex is reached. They may be detected roentgenographically as a ribbon-like shadow of increased density, with a sharp inner border appearing in the outer zone of the chest, and as the fluid increases, this shadow increases in width and extends down to the diaphragm. At this stage there is an area of clear lung between the edge of the fluid and the root; not until the increase in this shadow reaches the outer edge of the inner zone does it tend to accumulate at the base. Finally, the effusion extends upward in the inner zone producing the character-

FIG. 4. SACCULATED PERSISTENT PNEUMOTHORAX ABOVE AN OLD DRAINING LEFT EMPYEMIC CAVITY. RETAINED PARTICLES OF BIP.

istic cup-shaped upper border. This peculiar roentgen finding continues until the effusion is nearly complete, when the entire side is filled with a dense shadow so that, at this time only, is there a distinct displacement of the mediastinal contents to the opposite side.

With a thorough appreciation of these facts, there is no reason why any difficulty should exist, at this stage of the disease, in ascertaining the presence or absence of fluid roentgenographically. Even positive findings should always be confirmed by a diagnostic aspiration.

It is the opinion of the Empyema Commission, headed by Major Edward K. Dunham, that this class of cases should not be operated until the effusion has become frankly purulent and the patient has recovered from the pulmonary lesion; exception is made only in cases of acute pneumothorax, when surgical measures are urgent. Lung pressure symptoms and displacement of the heart are meanwhile relieved by aspiration. The number and frequency of chest aspirations is determined by the rapidity of the reaccumulation of the fluid.

The improvement in the lung condition and the change in the character of the fluid occur as a rule in from two to three weeks, by which time adhesions have had an opportunity to form. This prevents a complete collapse of the lung when the pleura is opened. In addition, the patient is in a much more favorable condition to withstand the surgical procedure.

It has been the experience of most men familiar with streptococcus empyema, that in this infection the pleural thickening and formation of adhesions are much more extensive than in cases due to other infections. This very excessiveness of adhesions may have resulted in a sacculation of the fluid, so that it is essential before operating that the surgeon should have as accurate a localization of the exudate as is possible. This can be accomplished only by a thorough fluoroscopic combined with a stereoroentgenographic examination, confirmed by aspiration. This examination as a rule should be made on the day of the contemplated thoracotomy.

As soon as the pus is evacuated the Commission recommends the immediate institution of the Dakin treatment. For the first few days a simple suction apparatus is applied which permits of a frequent irrigation of the empyemic cavity with Dakin solution, as well as providing free drainage. As soon as the patient is able to be up and around, he is dressed daily, at which time fresh Carrel tubes are reinserted. In isolated instances it has been found convenient to control the position of the tubes by the roentgen-ray.

The daily dressing and the frequent instillation of Dakin solution is continued until the cavity becomes sterile, the case being constantly under bacteriological control. During the entire period special attention is paid to the patient's nutrition, his excessive nitrogen output being balanced by food, giving a daily value of at least 3300 to 3600 calories.

While the Dakin treatment is carried on, every effort is made to assist in the expansion of the lung by such auxiliary measures as the use of blowing bottles, mild exercises, etc.; so that in most cases, by the time the cavity has been made sterile, the visceral pleura has become adherent to the parietal layer, obliterating the cavity; the small remaining sinus is then allowed to close. While the lung is expanding, frequent roentgen ray examinations should be made, preferably by the stereoscopic method, the roentgenograms acting as a permanent record of the favorable progress of the case.

In a certain percentage of patients, even after the empyemic cavity has become sterile, the lung fails to expand completely on account of pleural thickening and adhesions, leaving a cavity of varying size; these cavities require continued Dakinizing, until it becomes evident that a permanent closure can be accomplished only by further operative measures. Valuable information as to the existing conditions in

these cases can be given to the surgeon by the roentgen ray examination.

Stereoroentgenographic examination after the injection of some substance opaque to the roentgen-ray has been found to be of value in certain cases with large cavities complicated by auxiliary sacculations, and which, on account of their peculiar configuration, are notoriously difficult to sterilize.

The persistence of small draining cavities or sinuses, even after they have been rendered sterile, is one of the most trouble-

FIG. 5. OLD RIGHT EMPYEMA. DRAINAGE WOUND HEALED THREE MONTHS. RE-ACCUMULATION OF FLUID. PLEURAL THICKENING.

some problems the surgeon has to deal with. It is due to the following:

1. Sequestration of the rib.
2. The formation of a fibrous or bony wall around the sinus.
3. Too long retention of the drainage tube.
4. Imperfect drainage.
5. The presence of a pleuropulmonary fistula.
6. A rigid-walled cavity which prevents the expansion of the lung.
7. The presence of foreign bodies.

The roentgen ray examination, both with and without injection, should be resorted to before surgical measures are undertaken; in many cases the cause for this nonhealing can be ascertained.

There remains for consideration that important group of cases which have been allowed to heal prematurely and which have either a reaccumulation of the pus at the site of the former empyema, or in a new location. It may be within the substance of the lung. In those cases the pleura is great-

FIG. 6. SAME CASE AS NO. 5 AFTER ASPIRATION. 100 C.C. OF CLEAR STERILE FLUID REMOVED. NOTE THE DIFFERENCE IN DENSITY TO THE SHADOW AFTER ASPIRATION.

ly thickened, sometimes to over an inch, which renders an exact differentiation of these conditions extremely difficult.

We have also observed a number of patients with a persistent pneumothorax enclosed within a dense fibrous wall after the healing of the thoracotomy wound. Such cavities occasionally become filled with an exudate, the discovery of which is rendered difficult because the density of the fluid contents is similar to the thickened pleura. We have arrived at the conclusion that we can do little more than call attention to the shadows seen, and state

the various possibilities; the aspirating needle finally clears the diagnosis. If repeated aspirations are also negative, providing time will permit, careful and repeated roentgen ray examinations may in a certain number of cases clear the uncertainty. Pleural effusions, no matter how small, seldom remain stationary; even in old cases they usually increase slowly, so that there is a steady change in the contour of the shadows. On the other hand, pleuritic thickenings alone have a tendency toward slow but progressive diminution. If the case has been under observation before the reaccumulation has occurred, comparison with previous roentgenograms may assist in arriving at a diagnosis.

Special attention should be paid to the site of the old sinus tracts which are particularly favored locations for reaccumulations of fluid.

Similar difficulties are encountered in the roentgen ray examinations of cases which have never been operated and which were treated merely by aspiration.

In general it may be stated that the shadow of pleuritic thickening alone is rather more clear cut in detail than when fluid is present, as the latter produces a certain amount of haziness.

Unless there is a specific contra-indication all draining cases should be examined from time to time roentgenographically.

Fig. 8. Old Healed Left Empyema. Reaccumulation of fluid at site of former drainage wound. Clear sterile fluid aspirated. Diaphragm caught up in pleuritic adhesions.

Fig. 7. Old Right Empyema. Drainage wound healed three months. Operative findings: pleural abscess containing about 10 c.c. of pus with the surrounding pleura about one inch thick.

It is preferable that this examination shall be complete, i.e., by fluoroscopy and by stereoroentgenography. If the information obtained is not satisfactory, the examination is repeated by the same methods after injecting the cavity with a solution or paste containing a substance opaque to the roentgen-ray.

In my experience, bismuth pastes are the most satisfactory for the following reasons:

1. Pastes when properly warmed can be readily injected into the cavities.

2. Pastes are retained without difficulty when slightly cooled.

3. Fluoroscopic examinations in any position can be readily made without the risk of an escape of the injected mass.

4. A clear detail of the sinus as well as the cavity is obtained.

5. The pastes are non-irritating.

6. A possible therapeutic effect may also be considered, although the writer has thus far failed to detect any notable benefit. One has but to see the rigid walls of the sinus and cavities on the operating table to appreciate that surgery alone can achieve a cure. Two or three cases of small sinuses healed after the injection, but we are of the opinion that they came under the class of too long retention of the drainage tube and that it was the removal of it that permitted a closure of the sinus.

Fig. 9. Old Rigid Walled Right Empyemic Cavity. Injected with bismuth paste.

The objections to the use of bismuth pastes may be classified as follows:

1. The danger of poisoning by absorption.

It was appreciated at once that there was a possibility of poisoning when large cavities were filled with the paste. The writer has frequently used bismuth subnitrate in paste form as high as 33 per cent without deleterious results. Proper attention should always be paid, however, to the selection of a pure drug. Most reported cases of intoxication have been due to the presence of nitrites.

2. The danger of reinfecting a sterile cavity.

There is no valid reason why bismuth pastes cannot be sterilized, and when injected with proper aseptic precautions, the danger of reinfection of the cavity is negligible.

3. The difficulty of removal.

This is no doubt one of the principal disadvantages of pastes. In a measure it can be overcome by washing out the cavity with warm sweet oil.

4. The possibility of the paste obstructing the tube and interfering with drainage.

This is a justifiable objection. The knowledge of this possibility, however, will, as a rule, prevent any serious results. The dressings should be carefully watched for a

Fig. 10. Old Rigid Walled Sinus Remaining after a Right Empyema. Injected with bismuth paste. Note detail of cavity as well as tract of sinus. Operative findings showed peculiar configuration of the cavity due to small prolongations extending out into the thickened pleura.

cessation of the drainage; the temperature should be frequently taken, as a sudden rise would indicate retention; and appropriate measures should be taken to combat it. The difficulties met with are almost entirely limited to large cavities; after some trial, the bismuth paste was discontinued in these cases. Small cavities and sinuses, especially if there was a free opening, never gave any trouble, and were most satisfactorily outlined by the paste.

Mixtures of varying strength were tried; but it soon became evident that if a paste was to be used at all, it must be of sufficiently high density to accomplish the

object desired, namely, to outline clearly the entire sinus and cavity.

After considerable experimental work it was decided to use a paste made up as follows:

Bismuth subnitrate	25	per cent
Vaseline	73	" "
Wax	2	" "

This mixture has been most successful in the writer's hands.

FIG. 11. OLD RIGHT EMPYEMIC CAVITY. DIFFICULT TO RENDER STERILE ON ACCOUNT OF PROLONGATIONS. INJECTED WITH BISMUTH PASTE.

The use of bismuth subnitrate was not a matter of choice; it was used because no other salt of bismuth was available. Bismuth subcarbonate or oxychloride will give the same satisfactory density to the shadows without the danger of poisoning.

There is one condition in which it is impossible to use anything but bismuth paste, namely, the presence of a bronchial or pleuropulmonary fistula. Our experience has been limited to seven cases; out of this number we have been able accurately to demonstrate this condition in six. The positive evidence is convincing, the negative is of little value. Solutions in contradistinction to pastes are rather dangerous in these cases, as they produce spasm and severe coughing, which last for a considerable period of time.

FIG. 12. OLD PERSISTENT SINUS FROM A LEFT EMPYEMIC CAVITY WITH IMPERFECT DRAINAGE. INJECTED WITH BISMUTH PASTE. NOTE DETAIL OF SINUS.

As the use of bismuth paste was objectionable in large cavities, we were forced to take recourse to other substances. We mention particularly the following:

1. On account of their comparative cheapness, solutions of iodide of potassium or sodium in varying strengths were tried. It was found that 20 per cent solutions of these salts gave satisfactory shadows. Unfortunately, they were found to be too irritating; the patients complained of pain and had severe respiratory spasm and cyanosis; so severe were these symptoms in some cases, that the use of these solutions was discontinued.

FIG. 13. OLD PERSISTENT SINUS FROM A RIGHT EMPYEMIC CAVITY. RETAINED DRAINAGE TUBE. INJECTED WITH BISMUTH PASTE.

2. The most satisfactory, and the one now generally used, is a 15 per cent neutral solution of thorium nitrate. It is quite

expensive, especially when used in quantities sufficient to fill large cavities, but is much less irritating than the iodides, although in two cases quite a severe hemorrhage followed its use. It has the advantage of being a clear watery solution, which

FIG. 14. DRAINING RIGHT EMPYEMA WITH PLEURO-PULMONARY FISTULA. INJECTED WITH BISMUTH PASTE.

can be readily washed out, and does not in any way interfere with drainage, or the continuance of the Carrel-Dakin treatment. We believe, however, that any in-

FIG. 15. OLD DISCHARGING SINUS FOLLOWING THORACOTOMY FOR RIGHT EMPYEMA. INJECTED WITH BISMUTH PASTE SINUS COMMUNICATED WITH A BRONCHUS THROUGH A PLEURO-PULMONARY FISTULA.

jection into large cavities should be avoided, if possible.

In complicated cavities of considerable size the patient is placed on the table in such a position that the opening into the chest is uppermost. The requisite amount of thorium solution is now slowly injected with a blunt-pointed glass syringe of about 30 cc. capacity. The patient should be

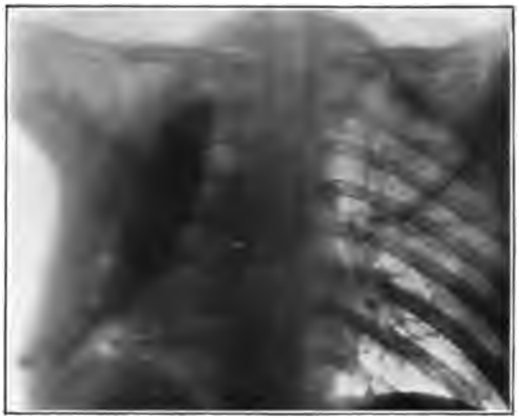


FIG. 16. LARGE LEFT EMPYEMIC CAVITY. INJECTED WITH A 15% SOLUTION OF THORIUM NITRATE.

warned not to make any unusual respiratory effort, as quiet and shallow breathing gives the best results, permitting a perfect filling of the cavity.

FIG. 17. LARGE RIGID WALL LEFT EMPYEMIC CAVITY OUTLINED BY INJECTING A 20% SOLUTION OF POTASSIUM IODID.

In the use of watery solutions, some difficulty arises from the fact that it is not easy to close the opening in such a manner that the fluid does not escape when the

patient is placed in proper position for the roentgen ray examination. We have found the best plan was to plug the opening firmly with a generous piece of sterile gauze

FIG. 18. OLD LEFT EMPYEMIC CAVITY INJECTED WITH A 20% SOLUTION OF BISMUTH SUBCARBONATE IN SWEET OIL.

packing, covered with a piece of rubber dam; this dam is firmly strapped down with wide adhesive strips at its edges, and a lead marker attached to an adhesive strip is placed over the wound.

Even with these precautions, there is always some escape of fluid, so that fluoroscopy after the plates are made is often unsatisfactory, as leakage produces adventitious shadows.

When dealing with small cavities or sinuses, the same technique is employed, except that the sterilized bismuth paste is substituted for the thorium solution. A graduated glass syringe is used to measure the quantity injected. The appropriate amount of paste required for each case is sterilized in separate receptacles, so that there is no danger of contamination from one case to another. After the injection, one can safely complete the entire examination, including fluoroscopy in all positions without danger of escape of the paste.

If a bronchial fistula be suspected, unusual care should be exercised in introducing the paste. The injection must be made very slowly, frequent inquiries being made of the patient as to whether he feels like coughing or whether he tastes the injected material. An attack of coughing, while not harmful, may clear the bronchi of the paste, and the very detail we are desirous of obtaining may be lost. After the completion of the examination, the cases should be immediately sent to the surgeon for proper dressing.

ADDENDUM

Owing to the difficulty of obtaining thorium solutions, the author, at the suggestion of Lieutenant Stevens, substituted a 20 per cent. solution of subcarbonate of bismuth in sweet oil, or liquid albolene. This was found very satisfactory for outlining cavities of moderate size, especially those with small external openings. In cases of small cavities with generous openings, the sweet oil solution has no special advantage; it does not give the detail that is obtained after using bismuth paste, providing the paste be thoroughly liquefied before injection. The oily solutions have the same objections as those of thorium, namely, that the opening must be tightly sealed after the injection in order that there may be no leakage when the patient is examined fluoroscopically in the erect position, a very necessary procedure. Some of the important advantages of its use over the paste are that it can be readily removed and does not interfere with drainage—two points which certainly appeal to the surgeon. Proper judgment should be used in each individual case in the selection of the opaque substance to be injected.

All cases where bismuth in any form is used should have a generous drainage opening and care should be taken to remove as much of the injected material as possible after the examination is completed. Retention of bismuth injections renders the patient liable to poisoning, as occurred in one case where a 20 per cent. solution of bismuth subcarbonate in sweet oil was used.

The author wishes to express his appreciation of the aid given by Major A. V. Moskowitz in the preparation of this paper.

SOME NON-TUBERCULAR PULMONARY CONDITIONS*

BY ALFRED L. GRAY, M.D.

Major M. C., U. S. A.,

RICHMOND, VA.

THE object of this brief paper is to call the attention to certain more or less definite conditions observed in a considerable number of cases which have been referred for roentgen examination of the chest. Usually a provisional diagnosis of tuberculosis has been made, but in most instances there has been an absence of the complete clinical picture of tubercular involvement, or at least some diagnostic factor is at variance with the rest of the findings.

In the cases examined there has usually been a history of grip, tonsillitis, or even pneumonia of a mild type. Following the acute attack there persists an evening temperature, a rapid pulse rate, extreme weakness, continued loss of weight and a failure to return to normal, despite an absence of any definite indications of the true location of the cause. There may be very little cough or expectoration, and physical examination may reveal only a few moist râles, slight tubular breathing or impaired resonance, or these may all be entirely undistinguishable. The sputum, when present, will usually show pneumococci, staphylococci, and streptococci or influenza bacilli. These organisms are not diagnostic and hence offer little value in localizing the disease. There is apt to be a polynuclear leucocytosis, though in one of the cases here reported there was, at times, an absence of polynuclear increase.

Stereoscopic plates will usually show a thickening about the hilum, which extends along the main bronchial branches. The process, involving the smaller branches, gives to the lobe a coarsely striated appearance, the striæ radiating from the hilum but markedly different from the delicate fan-shaped areas sometimes seen in early tubercular involvement. There is also more or less interstitial infiltration or congestion giving to the area the appearance of a general increase in density through which may be seen the thickened bronchial tree.

The condition may be distinguished from:

1. Abscess, by the absence of a localized area of great density or the usual appearance of a fluid level in the upright or lateral position with a gas area above.

2. Lobar pneumonia, by an absence of the dense consolidation of the interstitial lung tissue without the appearances of abscess.

3. Lobular pneumonia, by the absence of discrete areas of lobular consolidation.

4. Tuberculosis, by the absence of tubercles or of the characteristic tubercular mottling.

From observing the course of the cases that he has had the opportunity to follow, the writer is convinced that the condition is a low grade of bronchitis and peribronchitis due to pyogenic organisms or, in a more developed form, a type of septic bronchopneumonia, which may run a subacute course for several months and terminate in complete recovery, or may proceed to abscess formation requiring surgical intervention to effect a cure.

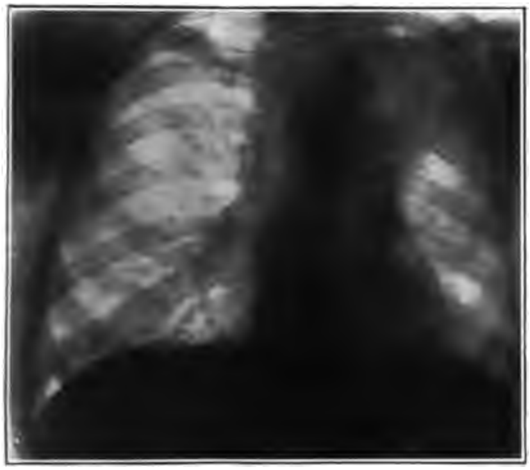
Illustrating the conditions, or different phases of the same condition, four cases are reported as follows:

CASE 1.—Mrs. K., white, female, age 67, presented the following history: The latter part of January, 1918, had an attack of lobar pleuropneumonia in the lower right lobe which ran a typical course with beginning resolution on the eighth day. At this time the lower left lobe experienced a similar typical attack. Following this a migratory pneumonia continued to involve

* Read before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Camp Greenleaf, Ga., September, 1918.

the left side. There was no crisis, but her elevation of temperature continued and on the 19th of April, 1918, a roentgen examination of her chest was made. A blood count at this time showed a lymphocytosis of sixty-eight per cent, polynuclears, twenty-four per cent. A sputum examination revealed staphylococci, pneumococci and influenza bacilli.

Roentgen-ray Report. — "Right Lung shows fine striations along descending



No. 1. Case 1. Mrs. K.

bronchial branches from hilum downward. There is a considerable fan-shaped area surrounding the hilum that is not sufficiently homogeneous for abscess but appears to accompany the bronchial tree. The upper left lobe shows a similar and more completely consolidated area but is striated and not evenly consolidated."

Conclusion.—"The condition is apparently not an abscess but an inflammatory bronchial and peribronchial process, probably a bronchopneumonia confined to these lobes, but not involving the parenchyma of the lung to a marked degree. There is also a considerable mediastinitis."

Case 2. C. B., white, male, age 12. Admitted to hospital April 14, 1918, following a paracentesis for otitis media. His ear steadily improved and his temperature receded, but continued to fluctuate from normal to 100° F. and occasionally to 101° F. His blood count showed a leucocytosis ranging between 16,000 and 29,000 with polynuclear percentages of 76 to 92. No physical signs could be elicited.

Stereoroentgen examination on the 7th of May was reported as follows: "Patient has marked pleural thickening over right upper lobe. Linear tubal thickening and interstitial infiltration of apex above the clavicle."

No. 2. Case 2. C. B.

Conclusion.—"Condition is probably an inflammatory consolidation with no distinct abscess present."

This case progressed to complete recovery without operation.

Case 3.—D. K. J., white, male, age 38. History of tonsillectomy two weeks before on account of supposed pulmonary infection and pain in right foot, attributed to absorption from tonsils. Had previously had night sweats which persisted for a time, disappeared and returned after five months. Since tonsillectomy, patient has grown steadily weaker with increased

pulmonary symptoms. The left lung was found on physical examination to show higher pitched breathing in the upper lobe "as though compressed at the hilum." Blood examination showed polynuclears 86 per cent. Sputum examination showed absence of tubercle bacilli, but staphylococci, chains of diplococci and pneumococci abundant. He was referred on May 21, 1918, for roentgen-ray examination of bones of leg and for stereoscopic examination of the chest.

Roentgen-ray Report.—"Bones of the leg show no lesion."

No. 3. Case 3. D. K. J.

Chest.—"Diaphragm on right and left about the same height, surfaces smooth."

Right Lung.—"There is a greatly increased amount of connective tissue about the hilum and a dense area extends upward, broadening as it ascends, obscuring entire right apex. The descending bronchial branches are also thickened. Considerable fine studding is seen in the base of the upper lobe and upward to the dense area mentioned above."

Left Lung.—"There appears to be a large, soft gland at the hilum and a very slight studding outward from the hilum."

Conclusion.—"Patient has a slight recent tubercular infection chiefly in the base of the upper right lobe, but to some extent in the left. The dense area described is an inflammatory thickening of the mediastinal pleura and that over the apex. It is possible that there is a pus area within this thickening but the shadow is too dense to distinguish the condition within it."

The patient died August 8, 1918.

Case 4.—A. J., white, female, age 5. Admitted to hospital March 5, 1918.

No. 4. Case 4. A. J.

Operation March 8, diagnosis subacute appendicitis. Temperature increased the day after operation and continued high with slight remissions for ten days thereafter when she was referred for roentgen examination of chest and left hypochondrium for abscess. The report is as follows:

"Patient has a complete consolidation of the lower left lobe. Condition appears to be pneumonia."

A second examination two days later

showed "Left lung clearing up very much. Still considerable deposit near the hilum."

A third examination eleven days after the first showed lung clear except for small dense glands and calcified tubercles about

No. 5. Case 4. A. J. 2 days after No. 4.

each hilum. Leucocytes 9,200, polynuclear 56 per cent. On the day of first roentgen examination, leucocytes 14,600, polynuclear 77 per cent.

Upon examination of specimen, the pathologist reported: "Sections of appendix show no pathology."

Recovery was complete and uninterrupted.

This case seems to have been one of mistaken diagnosis and the child probably was not suffering from appendicitis, but

No. 6. Case 4. A. J. 11 days after No. 4.

from some form of intestinal toxemia. The pneumonia was the result of the anesthetic.

This last case is included for purposes of comparison and to show the roentgenographic records of the progress of the lobar type of pneumonia from its height to complete resolution.

EMPYEMA, ITS PATHOLOGY IN RELATION TO ROENTGEN-RAY EXAMINATIONS * †

BY ROBERT A. KEILTY

Major, M. C., U. S. A.

PHILADELPHIA, PA.

THE purpose of this paper is to discuss the pathology of empyema in so far as it relates to the roentgenologist.

The word *empyema*, by general usage, has come to be applied loosely, too much so from the strict pathological sense. We are being reminded constantly by our surgical friends that their methods are based upon pathological principles. Let us not in the rush and enthusiasm of war work get away from these principles which have been founded upon years of keen observation. I have frequently heard men discussing empyema very broadly, and making a point of the fact that the cases encountered during the past winter's epidemic were of a different type and varied in the pathology from those that they were accustomed to see during civil practice. From my own experience, in autopsies of more than a year at this hospital, I cannot see that there has been any variance whatsoever from well established findings. There has been, however, an increase in the number of cases, interest centered around them, and facts which had probably been lost sight of were surrounded by an undue importance. The terms *empyema*, *pleurisy*, and *pleuritis* are not definitely established in the minds of most clinicians, and this is, I think, one of the major reasons for the variance of opinion.

Pleurisy should be dropped from the nomenclature entirely. It is a poor synonym for pleuritis, which is a better term and can be more definitely subdivided. Empyema of the pleural cavity is a pleuritis, but a pleuritis is not necessarily an empyema. The term empyema should be restricted to those cases which have a definite localized and walled-off collection or collections of pus in the pleural cavity. Empyema would be defined, then, as an accumulation of pus confined within the pleural cavity. By pus, I mean pus cells, débris of exudate and transudate, infecting bacteria, products of lytic and enzymic action and fats. Empyema is thus reserved for a definite class of cases and does not include any other type of inflammatory exudate. The term *pleuritis* includes all types of inflammatory processes of the pleura and is classified as follows: Pleuritis, acute and chronic: the acute is subdivided into fibrinous, serofibrinous, and purulent. Empyema is a type of the latter. There may be accumulations within the chest of several different types of inflammatory fluids which are not empyematous. If this fact is borne in mind, much confusion will be eliminated.

The typical case of empyema occurs late in the chest development and has had a chain of pathological forerunners. It cannot be denied that occasionally a case may be primarily an empyema, but this is very rare and is usually in association with the polyserositis group. The usual history begins either with sore throat or bronchitis, often exanthemata, and has as its portal of entry the upper respiratory tract. The disease extends as a direct respiratory disease, becoming rapidly either a pneumonia of the lobar type or more gradually a lobular or bronchopneumonia. The pleura, involved as a part of the general reaction, is always of the exudative type at first, that is, fibrin and fluid with few cells. The pleuritic area is usually uniformly affected.

In the lobar pneumonias, the expansion of the lung, by its exudate from within, forces it against the side of the chest and the plastering and sticky character of the

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exudate holds it there. This mechanical force influences, to a great extent, the position of the empyema developing secondarily. As a principle, fluid gravitates to dependent positions. In the chest, with the patient in the recumbent position, there are two levels for fluid collection in the presence of a fibrinous exudate. The one is posteriorly against the parietal pleura and at the base of the complemental space, and the other is anteriorly over the lung and beneath the sternum. The latter position is made possible for an accumulation by the fact that the fibrin has plastered the lung against the chest wall laterally. This is probably truer on the left side—where the influence of the heart is felt—than on the right side.

The collections are always greater in amount posteriorly than anteriorly. They are more likely to be posteriorly in one large area, while anteriorly they tend to collect in numerous smaller ones. The interlobar collections may occur at any position, again very often dependent upon the plastering of the exudate. From my own experience, the latter group of cases has been quite uncommon and present only in small collections. From this experience, I cannot help but feel that when the diagnosis is made so frequently, clinically and by roentgen-ray plates, there must have been some mistake in the interpretation of an intralobar condition.

In the bronchopneumonias the increase in the size of the lung is not so marked and thus the force from within does not hold the lung out against the chest wall as in the case of the lobar type. In these cases the collections are more definitely posterior and even lateral, but not so likely to be anterior. Here the pressure of the fluid is felt against the lung and the latter is likely to be pressed against the median line.

In the development of empyemata the change taking place in the exudate from a false membrane type to a suppurative one may be brought about in different ways. These exudates are primarily of pneumococcic or streptococcic origin, or both. These organisms do not call out pus cells in their first reactions but rather the serofibrinous character of exudate. Such exudates, being acute, cannot remain as such, but must either be removed or organized. The process of removal is responsible for a migration of leucocytes, which in turn changes the character of the exudate to a fibrous one; thus the products of pus are walled off by a permanent structure of fibrous tissue, which obliterates that part of the pleural cavity involved. This process ordinarily takes from two to three weeks and it is at this point that true empyema may be said to exist. The invasion by secondary pyogenic organisms may in addition change the character of the exudate from a fibrinous to a purulent one and thus be responsible for empyema. In lobular pneumonia when the entire cavity is filled with pus the fibrosis takes place in the pleural covering of the lung; in its contraction it helps in the reduction and atelectasis of the lung, which in the end may be flattened against its hilus, literally like a pancake. Such a collection is liable, by pressure, to extend well over beyond the midline to the opposite side.

SUMMARY

The problem of empyemata as it relates to the roentgenologist has to do with diagnosis.

The types of cases and their classification must be definitely understood, else the conclusion will be misleading.

The streptococcus and pneumococcus are primarily responsible for most of the cases with pyogenic organisms as secondary invaders.

This being the case, the early manifestations of pleuritic involvement belong to the pleuritis acute group and are characterized by serofibrinous types of exudates. The amount of fluid which accumulates is not very great as a rule.

The changes in the character of the exudate from a fibrinous to a purulent one are accompanied by equal changes in the nature of a wall in other parts of the

exudate, whereby the fibrin is organized into fibrous tissue.

I should like to lay stress upon these changes and advise the more frequent use of the roentgen-ray laboratory from day to day. I have, on several occasions, seen roentgen-ray reports at autopsy which were quoted and which had been made several days prior to death. The conditions then found were entirely different from those found by roentgen-ray examination. This was not due to faulty plate interpretation but to changes in conditions. With these exudative changes it is not so much a matter of hours but of days, and as a working rule I should advise repeated examinations every three days. In this way, a large number of cases studied over a period of perhaps five weeks, from the beginning of pleuritic signs to the definite walling off of an empyema, would be most instructive.

ROENTGENOLOGY AS A METHOD OF STUDYING THE NATURAL HISTORY OF DISEASE*

The author wishes to express his appreciation for the inspiration and material help in the preparation of this article which he received from Major Dudley D. Roberts and for the hearty coöperation of the other members of the staff at General Hospital No. 1, especially Major Edward G. Cary and his associates, in the pathological study of cases and specimens.

BY LEWIS GREGORY COLE

Major, M. C., U. S. A.

THE roentgenogram is a record of the varying densities of normal and pathological tissues. The value of the roentgenogram is directly in proportion to the accuracy with which the roentgenologist interprets pathological lesions from these varying densities. The accuracy with which this is done is directly dependent on the breadth and depth of the roentgenologist's knowledge of pathology. In bygone days the pathologist was an artist who could cut the thinnest sections by hand with a razor. The microtome changed that, and he became a scientist who studied the sections and interpreted his findings in terms of disease (pathology). In more recent days the roentgenologist was the artist who, with a gas tube, coil and some kind of interrupter, could make the clearest roentgenograms. With the advent of the Coolidge tube, roentgenography ceased to be an art and became a simple mechanical procedure.

Like pathology, roentgenology has become the science of the study of diseased tissues, and the interpretation of the findings in terms of pathology, not necessarily of etiology.

That there may be no misunderstanding we will clearly define what is meant by "roentgen findings" and how they differ from "roentgen diagnosis."

The term "roentgen findings" is applied to varying densities of the plate caused by the interposition of normal or diseased tissue. Such terms as filling defects of the stomach, cloudiness of the left apex, or an increased density over the right lower thorax, are simply descriptions of varying densities of the plate and are not expressions of pathology.

The "roentgen diagnosis" is a man's personal interpretation of the roentgen findings in pathological, but not necessarily etiological terms. Eastmond has compared it with two physicians listening to the same chest; both heard the same sounds or detected the same findings, but one interprets the physical signs as pneumonia, and the other as pleurisy with effusion.

The physician is a good or poor diagnostician according to his ability to interpret the physical signs in terms of pathology; likewise the roentgenologist is good or poor according to his ability to interpret correctly the roentgen findings in terms of pathology.

It may be wise to describe the roentgen

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findings thus: "There is a smooth homogeeous shadow involving the lower part of the right thorax gradually curving up from the dome of the diaphragm and running parallel with the chest wall."

The roentgenologist should be better qualified to interpret those findings into a roentgen diagnosis than the physician would be to whom such a report is made. The roentgen diagnosis would be pleurisy with effusion or a non-sacculated empyema. The clinical history, or even a thoracentesis, might be necessary to differentiate between certain conditions; but, again, let me protest against the roentgenologist making the roentgen diagnosis on the clinical history.

The service is offering a wonderful opportunity for the comparative study of roentgenology and pathology, to the advantage of the roentgenologist; and is stimulating a more thorough necropsy, especially in a search for the tissues which cause unusual roentgen findings. If the roentgenologist is to become more than a technician he must have a thorough knowledge of pathology. While acknowledging my own limited knowledge of pathology, I still maintain that pathology is the foundation on which roentgenology must be built, and I also have a vision of roentgenology contributing more materially to pathology.

Routine necropsies in the past failed absolutely to reveal the frequency and importance of certain pathological processes until they were demonstrated on the operating table. I refer particularly to postpyloric ulcers. We may, therefore, contend that pathology is by no means a finished book, and that there are diseases of many parts of the body open to further elucidation by other than a study of dead tissue.

The term "living pathology" has been usurped by the surgeon, but the roentgenologist may also lay claim to this method of examination. Roentgenology gives a clearcut idea of deviations from normal without the distortion that is incident to the removal of the parts at the time of necropsy. The removal of the lungs breaks up the adhesions and destroys the pockets, which are most important in the study of the "natural history" or clinical course of an empyema. Roentgenology combined with pathology is the method *par excellence* for the study of the natural history of certain pathological processes, particularly those of bones, lungs and certain parts of the gastro-intestinal tract. The works of Fennister on bones and Miller and Dunham on the lungs, are brilliant examples of this method of observation.

The limitation of pathology compared with roentgenology as a method of studying the natural history of disease is the *crux* of this communication.

Gross pathology in an individual case is limited to the study of the process at a single stage of its development, usually a late stage. The progress of the pathological process has been deduced from the study of a large number of cases dying at different stages of the disease. Therefore the natural history of the pathological process has been determined by a series of autopsies on similar cases, together with the clinical history of the patient.

This is like writing the history of a people by noting the racial characteristics of a great number of individuals. It is valuable and essential, but far less interesting than the life history of the country's great characters.

After it has been established by a comparative roentgen and pathological examination that a certain pathological process causes characteristic roentgen findings, the course or natural history of that pathological process may best be studied by a series of roentgenograms of an individual case made during the course of the disease—a biography, as it were, of an individual case.

The service has offered an exceptional opportunity for this method of study, and the object of the present communication is to stimulate its adoption by the members of this Society.

There are many moot questions and un-

solved problems in which periodical roentgenological examinations will be of inestimable value in the study of disease. The question of malignancy being engrafted on gastric ulcers is an example of the former, and the progress and resolution of pneumonia and the development and progress of empyema are examples of the latter.

McCarthy, of the Mayo Clinic, maintains that a large percentage of gastric cancers are engrafted on gastric ulcers. Ewing and Mallory and many other pathologists have failed to confirm this, and believe that only from two to six per cent are engrafted on gastric ulcers. It has been established that small gastric ulcers cause characteristic roentgen findings. McCarthy says that many of these small ulcers have pathological manifestations of malignancy, provided a sufficiently high-powered microscope is used; Ewing, Mallory and others maintain that the arrangement of the cells on which McCarthy bases his diagnosis of malignancy is not sufficient evidence to justify such a diagnosis. Therefore this is a most important moot question which it has been very difficult to decide.

If the ulcer is excised and examined microscopically, one pathologist will report it as malignant, and the subsequent history of the case may show that according to his opinion the case was one of gastric cancer cured by excision; while the other pathologist will report it as a case of simple ulcer, and subsequent history may show an ulcer cured by excision. This type of ulcer is readily recognized by roentgenological findings, and in my own experience I have definite evidence upon the question as to whether or not gastric ulcers frequently become malignant.

The onset, progress and resolution of pneumonia, the development of its sequelæ, particularly empyema, and the study of its course as evidenced by the fillings of pockets, recognized by periodical roentgenography and compared with the clinical history of the case, offer a remarkable field for the combined study of the roentgenologist and pathologist; and the service, particularly that part with which it has been my good fortune to be associated, has offered a remarkable opportunity for this method of study.

The following is a list of some of the pathological processes where a periodical roentgen examination is of practical value, not only in the study of the causes of the disease, but also as a factor in determining the method of treatment to be pursued, and whether or not surgical procedure is necessary:

(1) Pneumonia	Pneumococcus	
	Streptococcus	
(2) Empyema	General	
	Sacculated	

A. Diagnosis
B. Whether for surgical procedure
C. Location of incision
D. Location of accessory pockets if present

(3) Pleurisy with effusion
(4) Pulmonary tuberculosis
(5) Pericarditis

(6) Mastoiditis	Diagnosis and Progress	A. Before operation
		B. After operation

(7) Sinusitis

DISCUSSION ON LUNGS

Major Le Wald.—There is a point in differential diagnosis that really merits careful consideration. There are a number of cases recorded in the literature of operations for right-sided abdominal pain, supposed to indicate appendicitis, that turned out to be cases of pneumonia. I had a very early experience of that sort in an adult; and at the operation the condition was so striking that you might have said the appendix was really absent. There couldn't have been an acute appendicitis. There was a mere fibrous band of an atrophied appendix; and that case, on physical examination about four hours later, was found to have a well marked lobar pneumonia. The case went through the usual course and convalesced from his pneumonia. The pneumonia was present, or at least the initial phase was present, at the time the patient was operated on for the supposed appendicitis.

The point I wish to bring out is this: That was before it was customary to roentgenize cases of supposed pneumonia. Later on we had two cases in which there was typical right-sided pain with tenderness on pressure, and by roentgenographing these patients we were able to demonstrate a beginning pneumonia. We have records of these cases going on to a well-developed pneumonia, which resolved, and no operation was performed. That is, the roentgen-ray diagnosis differentiating between pneumonia and appendicitis is perfectly feasible and logical, and should never be omitted where it can be carried out.

In regard to Major Cole's case, the question of the demonstration of a heart shadow inside the pericardial effusion is new. We tried to carry out experiments on the cadaver to demonstrate the possibility of outlining the heart inside the simulated effusion, by injecting the pericardial cavity. We were not able to demonstrate that conclusively; and as far as I know, in the literature there has not been a differential diagnosis made in this way. Dr. Cole's demonstration seemed to be very conclusive on this point; and yet it is a matter of so much importance, and so much out of the ordinary experience of those who have attempted to demonstrate conclusively that one had a pericardial effusion by seeing the heart shadow inside an outer shadow which represents the fluid in the pericardial sac, that I should like to have some confirmatory discussion on that point.

Dr. George W. Holmes.—In the paper which Dr. Stewart has presented, some of the slides which were shown looked to me very much like pneumonias along with the empyema. I know that Dr. Stewart has proved his cases; and I would like him, if he will, in closing his discussion, to speak a little more fully of the differential diagnosis between a pneumonic patch in a lung which is compressed and the localized empyema which he has shown.

Dr. Stewart also spoke of the necessity of stereoscopic plates at all times. I agree with him that after operation and removal of the fluid it is necessary to have stereoscopic plates; but I have always felt that where there was simply fluid in the chest, a single plate, or even a fluoroscopic examination, was sometimes all that was necessary. It is a matter of considerable expense to take routine stereoscopic plates.

A thing which has interested me in these cases is the position of the diaphragm. Normally, the position of the diaphragm when the chest is open should be low. As soon as the negative pressure is removed in the chest the diaphragm goes down. In all the cases that Dr. Stewart has shown the diaphragm is high, which suggests, at least, that the diaphragm becomes adherent early and that this perhaps has something to do with the fact that the lung does not expand. If we attempt to get expansion of the lung by the usual methods while the diaphragm is fixed and high, the patient will simply produce an

emphysema in the other lung, because one cannot get air into a lung unless the diaphragm goes down. I would like to ask whether or not Dr. Stewart has had an opportunity to study any case where freeing of the diaphragm has been done.

The case of fluid in the pericardium which Dr. Cole showed is very interesting. I have for some time been particularly interested in this subject, and have gone over the literature fairly carefully. I have also had some experience with these cases, and I must agree with what Dr. Le Wald has said. I think before we accept the finding which Dr. Cole has described, we should have very conclusive proof; first, because it has never been done before, and a number of men have tried to demonstrate fluid in the pericardium in this way; and second, because it is rather against the physics of the thing. That is, there is no special reason why the heart, which is practically of the same density as the content of the pericardium, should show, unless there is air present.

Dr. Henry K. Pancoast.—I should like to support Cole. I was very much surprised to hear any adverse opinion in regard to the possibility of showing the shadow of the heart in a pericardial effusion. I am so certain of this that I have been in the habit of teaching it as one of the signs of pericardial effusion. When the effusion becomes of prodigious proportions, it is impossible to see the shadow of the heart. There seem to be very few signs in pericardial effusion. A sign upon which I have placed dependence as rather positive is the obliteration of the cardio-hepatic angle. I think Major Cole showed one case, and another was shown in the lantern demonstration in which the cardio-hepatic angle was not obliterated, but remained an acute angle.

Dr. Isaac Gerber.—I have had at least two cases where the border of the left ventricle of the heart was seen as clearly as in the illustrations shown yesterday by Dr. Cole; and in one of them I think the subsequent course of the case demonstrated clearly that the shadow we saw was actually due to the heart, because the first plate was a seven-foot plate, which presumably showed the true size of the heart within the partially distended pericardial sac; and a subsequent (seven-foot) plate, taken two weeks later, after the absorption of the pericardial fluid, showed the contour and size of the heart almost identical with the plate and shadow on the first plate. I felt that was proof positive that I really did see the shadow of the heart within the pericardial sac.

Maj. Willis F. Manges.—There was one striking slide in Major Cole's demonstration yesterday, that in which the effusion seemed to be almost entirely on the right side. While it apparently revealed a thickened pericardium it did not show any kind of effusion on the left side. My own belief is that if there is a pericardial effusion, it would be a most unusual thing to have it on one side only. I am inclined to believe that there was really a posterior mediastinal empyema rather than a pericarditis; it is not difficult to get the pus and feel that you have taken it from the pericardium. We had an almost identical case here last winter and traced out conclusively that it was a mediastinal—a more or less localized mediastinal—empyema, and not a pericardial effusion at all.

Maj. William H. Stewart.—As to Dr. Gray's paper: The presence of abdominal pain and tenderness with pneumonia, especially in children, is a common observation, and has been recognized for many years, and much has been written on that subject. Dr. Franz Torek, of New York, read a paper recently on that very subject, and laid particular stress on the character of the abdominal tenderness. He stated that it is almost a superficial tenderness. It is not a deep tenderness in the right iliac fossa. I find this especially true, as a number of cases that have come under

my observation showed that sign—that the tenderness is quite superficial.

In reference to the pericardium, I must support Dr. Cole. I have been able, I feel confident, to demonstrate the outline of the heart within a distended pericardial sac, particularly in one or two cases of general anasarca, in which we had a general effusion, pleural, abdominal and pericardial. We were able roentgenographically to state that the pericardial sac was markedly thickened, and we could distinctly see the cardiac outline within the shadow.

MAJ. A. L. GRAY.—Answering Majors Le Wald and Stewart, both of whom took up the question of whether or not the child whose slides I showed yesterday had pneumonia when it was operated on for appendicitis, the mental processes that have obtained in the minds of these gentlemen obtained also in my own mind at the time, and I went very carefully into the history and the laboratory findings to determine just that point.

In the first place, the blood-count showed a total leucocyte count of 9,500 when the child was brought in. It had been sick for some time, perhaps ten days or two weeks. The day, or about the time, that I made the first examination of this child's chest, as seen in the slide which showed the maximum consolidation, the leucocyte count was very much higher, and there was a very decided polynuclear percentage increase. Another thing: If you will recall, the pneumonia in this case was on the left side, not on the right. I wondered, when I discovered that the child had pneumonia, whether we had a case of left-sided pneumonia referred to the appendix, knowing that so often right-sided pneumonia is mistaken for appendicitis, and, as Major Le Wald said, the case operated on when there was no appendix involvement at all. The pathologists' report in this case was: No pathology whatever found in the appendix.

I want to add a word in respect to Major Cole's idea of demonstrating the heart inside the pericardial effusion. I am very certain that I have done it on several occasions; and what is more, whether it is possible or not, Major Cole has done it. The slides that he exhibited yesterday showed the outline of the heart inside the pericardium with an interval of from a fraction to an inch between the wall of the heart and the pericardium. Whether it is possible or not, I am inclined to think it is when you see it done.

THE ROENTGEN RAYS IN THE DIAGNOSIS OF APPENDICITIS *

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IN THE great majority of cases the roentgen rays are not necessary for the diagnosis of appendicitis. This is especially true of acute appendicitis. In chronic appendicitis, however, the symptoms are very often obscure and the clinical signs and other evidences of an inflamed appendix are indefinite or are complicated by lesions in other organs. In these obscure cases the roentgen rays will give the greatest assistance in making correct diagnosis.

Acute Appendicitis.—In acute appendicitis the roentgen rays are very rarely necessary to assist in the diagnosis, but at least two points of diagnostic value can be demonstrated in these cases. (1) In that group of patients in which are symptoms of acute appendicitis due to an early pneumonia developing in the lower lobe of the right lung, the roentgen rays will be useful in demonstrating the lesion in the lung, thereby aiding in differentiating pneumonia from appendicitis. (2) A valuable point in the diagnosis of acute appendicitis brought out by Case is obtained by filling the colon to demonstrate the relations of the area of acute tenderness, and thereby assist in differentiating appendicitis from other affections of the organs in the right lower quadrant of the abdomen.

Chronic Appendicitis.—The chronic appendix gives much roentgen evidence of value in diagnosis. In the great majority of instances the patients sent to me for study, and in whom I find chronic appendicitis, are referred because of obscure stomach symptoms, in which the diagnosis of gastric ulcer is suspected, but the evidence is insufficient for an operation. In other cases the gall-bladder or duodenum is under suspicion, but it is my opinion that in all this group of cases where the symptoms are variable and may refer to the stomach, the duodenum, the gall-bladder, the kidneys, the appendix or the bowel, that nothing short of a complete roentgen examination of the entire gastro-intestinal tract, including the gall-bladder and at times even the urinary tract, should be made in order to reach a definite diagnosis. I cannot insist too strongly upon this point.

Otherwise important evidence will be overlooked, for one may find more than one organ involved, or the affected organ may be overlooked entirely. If any of these organs are studied separately and nothing is found, the patient has not been benefited; his symptoms continue; no diagnosis is made, and generally he becomes disgusted with the physician and with the methods used in diagnosis, which is a detriment to everyone.

Technique.—In this general group of cases, therefore, it is my practice to order for the patient a purgative, such as a bottle of citrate of magnesia at nine o'clock on the night preceding the examination. The patient then reports at nine o'clock the following morning without any breakfast, at which time a thorough study of the gall-bladder region is made, using six or eight plates. The patient is then viewed fluoroscopically at which time any gross abnormalities in the chest are noticed; the abdomen is viewed in general, at which time occasionally a biliary calculus or a urinary calculus may be observed before giving the opaque meal. At times even a urinary calculus will give rise to these obscure gastro-intestinal symptoms. The patient is then given a barium meal, consisting of approximately two ounces of barium in a pint of buttermilk or one of the

* Read by title before the Nineteenth Annual Meeting of the American Roentgen Ray Society, Fort Oglethorpe, Ga., Sept. 6-8, 1918, entitled "The Roentgen Rays in the Diagnosis of Chronic Appendicitis and other Conditions in the Appendicular Region."

prepared fermented milks. This makes an excellent vehicle, as was originally demonstrated by me in 1907.[1] A careful study is then made of the stomach and duodenum, and if anything abnormal is found, the patient is again seen in three, four or six hours, depending upon the conditions. If nothing abnormal is observed at the first visit by a careful fluoroscopic examination, the patient is seen again at the end of eight hours, after the opaque material has entered the cecum and ascending colon, and one can make some of the preliminary studies with reference to the terminal portion of the ileum, the cecum, and, occasionally, at this time the appendix will be visualized. In some cases this is the only occasion at which the appendix can be demonstrated. Generally at this eight-hour period the appendix is not filled. The patient is next seen 24 hours after the first visit. At this time, in practically all instances, the cecum and ascending colon are well filled and, in the great majority of instances, the appendix can be demonstrated. The patient is allowed to continue with regular meals, after the first barium meal, unless something is found in the stomach or duodenum. No purgative is allowed during the entire study. At the 24-hour examination, studies are made with reference to the cecal region and the entire colon. The patient is next seen at the end of 48 hours, when further observations are made with reference to the ileo-cecal region, and the filling effect throughout the colon. The patient is then given a barium enema. This outlines the colon and further demonstrates its relation to other organs as well as its relation to the appendix. It also enables one to recognize any constriction or filling defect, and the patient does not have the objectionable drying up of hard barium masses, which sometimes gives trouble in their expulsion from the rectum.

The diagnostic points obtained through roentgenology are:

(1) *Localized Tenderness.*—This is the most valuable sign obtained, and is elicited either by direct palpation under the screen by means of the gloved hand, or much better (which is my practice), by means of a wooden spoon-like instrument, called a "distinctor." This wooden spoon can be passed readily under the screen and is controlled by the hand above the screen over the protection of the lead glass. If this spoon is surrounded by a rim of metal, one can easily move it around over the different parts of the colon, and different parts of the abdomen, and by watching the ring can definitely localize the tenderness of appendicitis in the cecal region or over the appendix, wherever it may be located. When the appendix is visualized (that is, when the barium meal enters the appendix so that it can be distinctly seen), one can often localize the tenderness directly over the appendix. When the appendix is movable, not infrequently the localized tenderness moves with the appendix. I have been able in a number of cases to move the appendix as much as three or four inches, and in each instance the sharply localized tenderness moved with the appendix. This may seem contradictory or inconsistent with some of the ideas of the sensibility of the viscera, but whether contradictory or inconsistent, it is a fact. Without suggesting to the patient, I have been able to move my wooden spoon around over the abdomen, and in each instance when I came back to the location of the appendix, the patient complained of pain even though I had moved the appendix from its original place. This tenderness is persistent and is present throughout the various studies made. At times this tenderness is acute and sharply localized, and at others is a more or less general and less acute tenderness. A vague tenderness is more likely when the appendix is retrocecal when there is considerable soreness; but the tenderness is not sharply localized until one twists the patient in such a manner as to bring the pressure directly to bear upon the appendix, in which instance it is often quite acute. If no tenderness is present and if at the same time the cecum is freely moveable, I believe that one can say that no

appendicitis exists. On the other hand, if there is localized tenderness over the cecum with fixation of the cecum and no visualization of the appendix, it very frequently means an obliteration of the appendix by inflammatory exudate which prevents the appendix from filling with the barium meal. Localized tenderness, with fixation of the cecum, and without filling defect, is, I believe, strong evidence of appendicitis. Clinically the surgeon and physician are apt to look for tenderness over McBurney's point. As we have many opportunities of studying the position of the appendix and the localized tenderness, we realize how much in error we may be if we depend upon localized tenderness over McBurney's point as evidence of chronic appendicitis. For example, if the appendix is located deep in the pelvis there will be absolutely no tenderness over McBurney's point. Likewise, if the appendix is located in the hepatic region, and very commonly when the appendix is retrocecal, there is no localized tenderness over McBurney's point. Then too the appendix may be on the left side instead of the right, either due to non-rotation of the colon or to complete transposition of the viscera.

(2) *Demonstration of the Appendix.*—The appendix can occasionally be demonstrated by the opaque enema, but in many more instances it is demonstrated by means of the opaque meal, particularly when the latter is administered with buttermilk. Case reported a demonstrable appendix in 273 out of 763 cases which were referred because of gastro-intestinal symptoms. George and Gerber have succeeded in demonstrating the appendix, either normal or pathological, in 7 out of every 10 cases. Quimby in 141 cases was able to obtain sufficient data to determine the condition and the position of the appendix in 90 per cent of them. The remaining 10 per cent were those in which the position of the cecum prohibited a thorough inspection. I believe that, in the majority of cases referred for gastro-intestinal study in which the barium and buttermilk meal is administered, the appendix can be demonstrated if one looks for it at the end of 8 hours, at the end of 24 hours and at the end of 48 hours. It is not always visualized in a plate made of this region but if one palpates the cecum by means of the wooden spoon or distinctor, and if the appendix has been filled with the barium, it can, I believe, always be demonstrated even if it is lying behind the cecum. To accomplish this, one should rotate the patient to the right or to the left sufficiently to bring the posterior surface of the cecum into view; the appendix can then be demonstrated if it is filled with opaque material. I believe that no case is thoroughly studied unless this procedure is followed. Regarding the significance of bismuth fillings of the appendix, Skinner, after reviewing the literature on the subject, states that there is no agreement. At one extreme we find Groedel stating that the ability to demonstrate the opaque filled appendix is a sufficient basis for accusing it of being pathological. Case is inclined to the view that the appendix which can be filled with bismuth, if not definitely pathological, is at least potentially dangerous. George and Gerber agree with Case in those cases where bismuth remains in the appendix 48 hours or more after it has passed out of the contiguous intestinal tract, while Imboden states that the mere presence of some of the opaque material still in the appendix is no indication of chronic disease. Cohen says that fecal contents enter normally into the appendix.

(3) *Fixation.*—A chronically inflamed appendix is very likely to become more or less attached to the surrounding tissues. It may be attached only at its tip, in which case the greater portion of the appendix could be moved around freely, together with the cecum, and yet the tip of the appendix remains in a stationary position. On the other hand, the appendix may be fixed throughout, or it may be fixed at its base, and the tip of the appendix may be movable. However, absence of fixation or evidence of adhesions about the appendix

must not be regarded as negative evidence in the diagnosis of chronic appendicitis, for we all know that an appendix may be inflamed and yet be freely movable. In this instance, the localized tenderness again is of most value.

(4) *Position of the Appendix.*—Normally the appendix is directed downward into the pelvis, but normally it is freely movable, and changes its position without external influence to a considerable extent during 24 or 48 hours. It not only changes its position but its shape, indicating that there is likely some vermicular or peristaltic movement associated with the appendix. One may find, therefore, a chronic appendix in a normal position lying in the pelvis, lying transverse or lying along the inner side of the ascending colon; it may be retrocecal or, as in one case of mine, the appendix was wound around the pyloric end of the stomach. In a number of cases I have found it up in the gall-bladder region, in which instances the patients are generally sent for a gall-bladder examination rather than an appendiceal study. In general, when the appendix is directed upwards or is retrocecal, it is more likely to indicate chronic appendicitis.

(5) *Kinking or Angulation of the Appendix.*—The mere bending of the appendix has no significance, for the shape of the appendix will vary many times within 24 hours, but if there is a fixed angulation it is very commonly due to an adhesion at the point of fixation. This has distinct significance.

(6) *Constriction.*—Constriction, dilatation, or irregularities in the lumen—these may consist of a bulbous portion, the whole appendix may be much dilated or one may have marked irregularity in the lumen. All of these, I believe, have pathological significance.

(7) *Abnormal Retention.*—If the appendix remains filled with barium after the cecum and ascending colon have become empty or after the entire colon is emptied, I believe that it has pathological significance. On this point I am in accord with opinions expressed by Case, George and Gerber, and Imboden.

(8) *Incompetent Ileocecal Valve.*—The incompetency of the ileo-cecal valve can often be recognized by the fact that at the end of 24 hours after giving an opaque meal, the ileum is usually entirely empty, and yet at the end of 36 or 48 hours the terminal portion of the ileum may contain some of the opaque material. This surely means, and is the best demonstrable proof of, incompetency of the ileocecal valve. It is due to regurgitation of the contents of the colon into the ileum, and is probably carried there by reversed peristalsis.

OTHER ROENTGENOLOGICAL EVIDENCE OF PATHOLOGY IN THE RIGHT LOWER QUADRANT OF THE ABDOMEN.

(1) *Enteroliths in the Cecum*, such as were demonstrated in the cases reported by Stamm and the writer.[2] In one of these cases the enterolith consisted of a fecal mass, globular-shaped, about an inch and a half in diameter, movable between the cecum and several inches higher in the ascending colon. It gave rise to pain in the right iliac fossa, and also was associated with recurring attacks of diarrhea. It was finally carried to the rectum, after many glycerine enemas, and was removed digitally from the rectum by the attending physician at the end of two months.

(2) *Adhesions of the Cecum to the Side of the Rectum.*—This condition is illustrated by the case of a young man who for 20 years suffered with constipation, but at the same time had constant desire for stool. Yet, no matter how often he emptied his bowels, he still had the desire for further rectal expulsion. This symptom was found to be due to a dilated cecum attached to the rectum. The cecum, becoming distended with fecal matter, pressed upon the rectum, gave the patient a desire for stool and the patient was continually making the effort to expel the cecum through the rectum; without success, of course. This patient was relieved by operation.

(3) *Carcinoma of the Cecum.*—Carcinoma of the cecum is associated with two of the most important roentgenological symptoms of chronic appendicitis, namely, localized tenderness and fixation. But one can differentiate these because of the filling defect in the cecum due to the carcinoma. This filling defect is practically always absent in connection with chronic appendicitis, excepting when a large appendiceal abscess is present, which produces a pressure defect. The pressure defect can be differentiated by the smooth rather than the serrated outline.

(4) *Psoas Abscess or Iliac Abscess*, which ultimately points to the neighborhood of Poupart's ligament, may give rise to localized tenderness, with a great deal of pain and distress, and the consideration of chronic appendicitis is often forced upon us. In these cases an examination of the spinal column will help to clear the diagnosis, and generally the cecum and appendix are found to be freely movable unless there is associated chronic appendicitis. The two conditions may, of course, be present at the same time.

(6) *Urinary Calculus.*—I have seen several cases operated upon for chronic appendicitis, when a subsequent roentgen examination demonstrated the presence of a ureteral calculus. Even renal calculus may give reflected pains in the right quadrant of the abdomen.

CONCLUSIONS

1. Chronic appendicitis commonly gives obscure symptoms.

2. A complete and careful roentgenological study will give valuable evidence in all cases.

3. A definite diagnosis, either positive or negative, can be made in the majority of cases.

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THE ROENTGENOLOGICAL FINDINGS IN A CASE OF PYOPNEUMOTHORAX SUBPHRENICUS DEXTER

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THOUGH there is an extensive literature on subphrenic abscess containing gas and it is a fairly well known condition, still it seems worth while, for reasons that will appear, to report the roentgenological findings in such a case. A search of the available roentgen-ray literature reveals but one example, that of Col. James T. Case in his "Stereoroentgenography of the Alimentary Tract." This, resulting from a perforated gastric ulcer, does not give particularly striking findings. Nyary has a description of a case in the *Deutsche med. Wchnschr.* (1915, No. 38), but his report is unaccompanied by illustrations. Medical writers generally content themselves with the statement that the roentgen-ray examination is helpful, or will clear the diagnosis, but are not precise in stating how this desirable end is achieved. As a matter of fact, the condition presents a characteristic and beautiful roentgen-ray entity, as will be seen in the case to follow.

Formerly of fairly frequent occurrence, pyopneumothorax subphrenicus is becoming less common as gastric conditions and appendicitis (the two chief sources whence it arises) receive their proper surgical treatment. It can hardly occur, save in a surgically neglected patient such as the subject of this report. He, prior to his coming to this clinic, had been treated for "worms."

An abstract of the history of this case, with the roentgen findings, follows:

Frank Y., aged five years, came to the Orthopedic Clinic of the Washington University Dispensary June 26, 1918, complaining of his back. Examination revealing that he was not an orthopedic case, he was immediately referred to the Department of Pediatrics. A history of an attack of vomiting four weeks previously, followed by pain in the abdomen, right side and back, with fever, was obtained. Fever and pain continued, accompanied by wasting and an increasingly bad condition. Physical examination being unsatisfactory and inconclusive, he was referred to the roentgen-ray department for a roentgenogram of the chest, and ordered to report the following day. This plate (Fig. 1, made in the prone position) showed heart apparently displaced to the left, slight scoliosis (convexity to left), lung fields clear, diaphragm disproportionately high on right side. Below the latter there was a clear, gas-filled triangular space, with the greatest side somewhat concave, directed downward and inward, the lowest point level with the tip of the eleventh rib. From this lowest point there extended a narrow gas-filled space towards the iliac fossa.

FIG. 1. PRONE POSITION.

The child, admitted to the Children's Hospital the next day, gave briefly the following findings on physical examination: Patient very ill; respiratory movement largely confined to the left side of the chest; liver dullness in the sixth interspace and midclavicular line. On the right side there was a space bounded above by a horizontal plane passing through the tenth thoracic vertebra, anteriorly by the anterior axillary line, posteriorly by the spine, and extending downward to an apex in the midaxilla at a point midway between the iliac crest and the costal margin, over which there was tympany to percussion; abdomen distended; liver edge palpated two cm. below costal margin throughout its extent. A definite, irregular mass was found in right lower quadrant, beginning in the pelvis and

Fig. 2. Erect Position.

extending up the right flank, seemingly continuous with the liver. A marked leukocytolysis existed.

Fluoroscopic Examination: Erect posture, right leaf of diaphragm immobile, excursion of left leaf increased. Below the diaphragm on right side was a reniform, clear, gas-filled space, the lower pole of which was cut off by a definite, horizontal, straight line. This line remained horizontal on bending the child laterally, and wave motion was elicited by shaking the patient. Postero-anterior view corroborated these findings. Supine posture showed the same conditions as the erect, save that there was less clarity over the area noted above. The

Fig. 3. Prone Position.

shape of the clear area changed from reniform to triangular. From the lowest point of this triangle, a narrow, gas-filled space ran down and internally toward the pelvis. Roentgenograms were made in these two positions. (Figs. 2 and 3.)

These findings warranted the roentgenological diagnosis of a gas-containing subphrenic abscess, probably originating from the appendix. Aspiration was performed, and a small amount of pus withdrawn for examination. It contained many streptococci and colon bacilli, and presented the general characteristics of pus from a chronic, walled-off abscess.

All methods of examination concurring in a diagnosis of abscess, immediate operation was decided on. Incision and drainage

were made by Dr. A. O. Fisher. A large amount of foul pus, gas and an enterolith were evacuated. A large cavity was found extending upward from the right iliac fossa, investigation of which was precluded by the patient's condition. Patient stood operation well, but his experience immediately following it was stormy.

Roentgenological examination made August 7, forty days after operation, gave approximately the same findings as those of June 28, save that there was no collection of fluid present. Fig. 4 (made in the supine position) shows condition on that date.

The child has gradually improved and is now quite well, save for a slight fecal fistula. Fluoroscopic examination on this date,

FIG. 4. SUPINE POSITION.

December 7, shows equal and full diaphragmatic excursion on the two sides and absence of the gas-filled space previously observed. Fig. 5 (taken in the prone position) shows the present condition.

A recapitulation of the salient features of the roentgen-ray findings in this case seems not out of place:

The presence of a collection of gas beneath the right leaf of the diaphragm,

FIG. 5. PRONE POSITION.

the outline of which is modified by change of posture. Its definite outlining of the peritoneal reflection composing the right lateral ligament of the liver, thereby assuring that it, the gas, lies intraperitoneally.

The collection being *external* to the right lateral ligament of the liver, eliminates the stomach and duodenum as the source of the affection. This same fact, taken in conjunction with the situation of the collection just beneath the lateral abdominal wall, practically assures the cecum, appendix or ascending colon as the primary seat of disturbance.

The existence of a fluid level below the gas when patient is erect, and the demonstration of its shifting on movement.

The existence of a narrow, gas-filled canal leading towards the pelvis, which implicates the appendix as the origin of the condition.

The relatively large amount of gas and small amount of fluid in the space, from

which the natural inference is that an opening into the intestine existed, allowing ingress of gas and egress of fluid, which was confirmed later by the development of a fecal fistula.

The absence of infiltration of the bounding tissues with gas, in contradistinction to the action likely to be found in gas bacillus infection and traumatic emphysema.

The slow collapse of the cavity after drainage.

The existence of an undamaged lung and diaphragm above.

In conclusion, I wish to express to Drs. P. C. Jeans and A. O. Fisher my appreciation of the privilege of reporting these findings, as the case belonged to their respective services.

COMPLICATIONS IN PNEUMONIA

BY F. E. DIEMER, M.D.*

Capt. M. C., U. S. A

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PLEURITIC effusions are most frequently found in the lower quadrants and are usually retained there by pleuritic adhesions. However fluid may be fixed or encapsulated in any position or location in either pleural cavity. Also it may be free in the pleural cavity and change its position and shape as the patient's position is changed. The patient should be in an upright position, as a small amount of fluid free in the pleural cavity may form a thin layer and be difficult of detection with the patient in the dorsal position. Protective adhesions are formed between the visceral and parietal pleura, at the junction of the inflamed and normal pleura, thus encapsulating the fluid. Encapsulations in the upper quadrant often follow drainage of a large collection in the lower quadrants.

Fluid in the lower quadrants may be located immediately over the diaphragm, occupying the entire costo-phrenic sinus, the lung being compressed entirely from below upward. It may be located anteriorly, posteriorly or laterally, or may occupy the entire sinus and compress the lung from the three sides rather than from below. The differential diagnosis is sometimes rather difficult from both plates and fluoroscopy, especially if the fluid is under pressure and very thick. The decrease in radiability is so marked that the diaphragm cannot be made out or the depth observed stereoscopically if the lung is so compressed that very little or no air enters it. On account of pleuritic adhesions following rib resection in the encapsulated cases there is usually very little lung collapse. If there are no pleuritic adhesions, marked lung collapse is not obtained on account of the lung consolidation. Pleuritic adhesions are formed before resolution begins, especially if negative pressure is applied at the beginning of resolution and

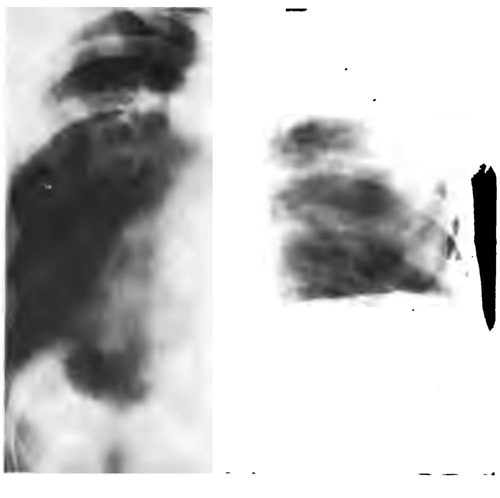

FIG. 1.
Encapsulated empyema, upper right quadrant.

* Authority to publish granted by Board of Publication, Surgeon General's Office, Washington, D. C.

before the visceral pleura is thickened and contracted.

In extensive pleuritic effusion under pressure with marked heart displacement

FIG. 2.
Encapsulated empyema, upper right quadrant. Note the interlobular adhesion.

and considerable lung collapse the heart silhouette will apparently be enormously increased in area and will suggest pericardial effusion. Confusion in this case is more likely to occur if the right pleural cavity is involved. Pericardial effusions produce a marked abnormality in configuration of the heart silhouette. The vesiculo-auricular angle on the right side

FIG. 4.
Extensive pleural effusion. No heart displacement. Interlobular adhesion right side.

is decreased in obtuseness, the result of the vesicular bulge and the right cardiac border is exaggerated. There is also an absence of the left auricular shadow and the pulmonary root shadow. The cardio-phrenic angle usually remains acute, especially on the right side. The left may become obtuse. We have had one case with purulent pericardial effusion which undoubtedly ruptured into either the trachea or a large bronchus. A quantity of offensive purulent material was coughed up. A roentgen-ray examination then showed a normal heart silhouette with indications of a thickened pericardium along the right border. (See Figs. 12 and 13.) The patient

FIG. 5.
Extensive pleural effusion (right).

died following a disseminated inspiration pneumonia, but the autopsy failed to reveal a communication between the pericardium and the bronchus. However, the pleuro-pericardial adhesions were very dense.

Encapsulated interlobular collections of fluid are very difficult to recognize. They are most often found between the right upper and middle lobes. This is probably because of the slight convex upper surface of the middle lobe and the tendency for adhesions to form between inflamed interlobular visceral pleura where it overlaps

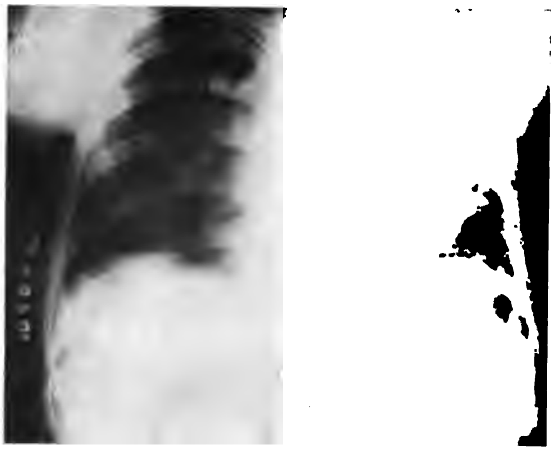

FIG. 6.
Encapsulated pleural effusion, upper left quadrant.

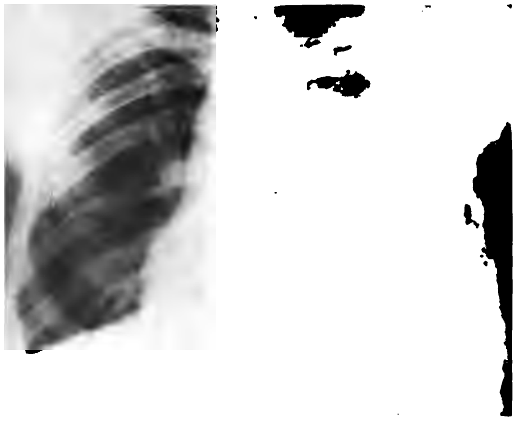

FIG. 9.
Left pleural effusion. (Note heart displacement.)

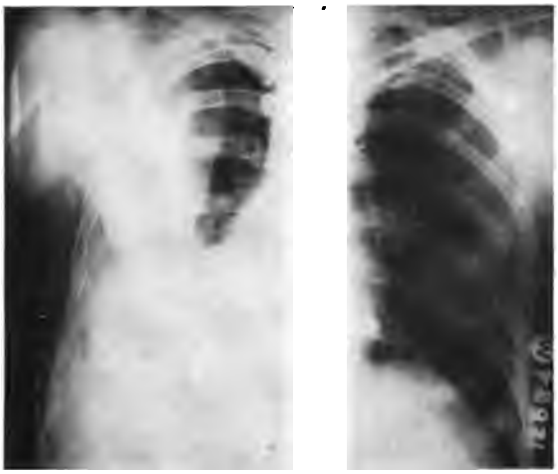

FIG. 7.
Encapsulated pleural effusion, upper left quadrant.

FIG. 10.
Pleural effusion, lower right.

FIG. 8.
Encapsulated effusion, upper right quadrant.

FIG. 11.
Pericardial effusion complicating confluent bronchopneumonia, upper left.

the visceral pleura covering the lobe. This causes retention of fluid between the lobes. These are noticed on a flat plate as fan-shaped uniformly dense areas with the apex at the hilus and the base at the lateral chest wall behind the fourth and fifth interspace in front. Stereoscopy determines the cone shape, most of which is thickened interlobular pleura, the fluid being usually small in quantity. This fluid is absorbed eventually or organized into fibrous tissue, but may increase sufficiently in quantity to rupture into the pleural cavity, producing a general pleuritic effusion.

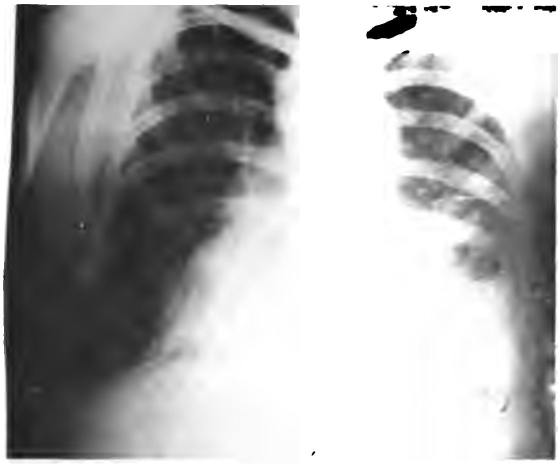

FIG. 12.
Pleural effusion, lower right. Pericardial effusion.

FIG. 13.
Same case as Fig. 12 following spontaneous rupture.

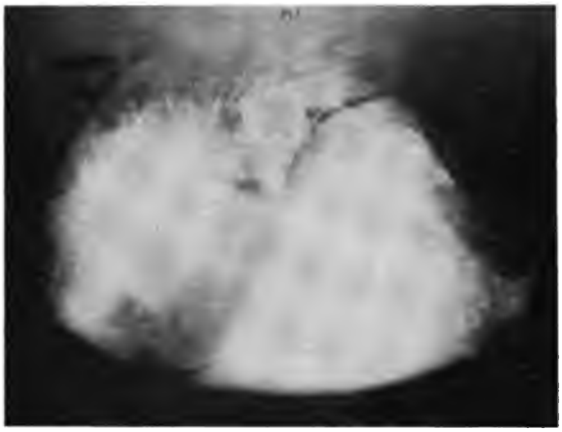

FIG. 14.
Emphysematous excavation. Exposure made after lung was removed.

We have noticed several cases of emphysema along the course of the pulmonary vessels. This is most marked along the surface vessels and apparently begins at the periphery and extends toward the hilus by dissection. Two of these cases eventually ruptured the visceral pleura and produced a spontaneous pneumothorax.

FIG. 15.
Pulmonary emphysema. Exposure made after lung was removed.

One of these cases developed into pyopneumothorax, the fluid being free in the pleural cavity. In pneumothorax the air is under pressure displacing the heart and diaphragm. The degree of pressure depends upon the degree of obstruction to the passage of the air out of the bronchiole back

FIG. 16.
General emphysema. No pneumothorax. Note air in axillæ.

to the bronchus. The emphysema along the vessel presents an elongated area of increased radiability extending from the periphery almost to the hilus. It is differentiated from a dilated bronchus because the borders are scalloped rather than uniform and because there are no indications of fibrous tissue infiltration as in bronchiectasis. We

FIG. 17.
Chest plate in general Emphysema, following rib resection. Note air in axillæ.

have detected several cases of emphysematous excavation. These are shown on the plate as large clear oval shaped areas, usually several in the same quadrant and not diffusely distributed. These areas are evidently not a true emphysema but excavations due to rupture of dilated air sacs. Hence the name "emphysematous excavation." Fig. 15 demonstrates a true general pulmonary emphysema, while Fig. 14 shows the excavation. From a roentgenological study of these cases and observation at autopsies we have determined that the mechanics of generalized emphy-

FIG. 18.
Pyopneumothorax, right. Note extensive pleuritic bands.

sema is probably as follows: There is a marked peribronchiolitis, the congestion producing an impingement on the lumen of the bronchiole causing a bronchiolectasis. Continued violent coughing increases the distention and a rupture of either a

FIG. 19.
Pneumothorax, left.

bronchiole sacculation or of a distended air sac results. Adhesions are formed between the soft areolar tissue of the anterior mediastinum and the thin inner border of the lung, when the pressure of air in either the distended air sacs or the emphysematous excavation becomes almost sufficient to rupture. If the pressure continues on account of increased impingement on the lumen of the bronchiole, the emphysematous excavation ruptures. Air is then admitted into the tissues of the anterior mediastinum and is distributed over the body until the pressure in the soft tissues balances the pressure distal to the constricted lumen of the bronchiole through which the air must travel to reach the anterior mediastinum. The process is mechanically the same as that which produces the dilatation of the secondary bronchus in bronchiolectasis. Pneumothorax results if adhesions are not formed between the lung border and the mediastinal tissue, or if the process takes place at another location on the lung surface.

In old, chronic pleuritic effusions the pleura is so thickened that the rib outline cannot be made out except at the lateral chest wall where the fluid is thin. These cases seldom show marked heart displacement, because the pleural fibrosis eventually contracts and pulls the heart back, the pressure on the fluid causing absorption and finally organization until only a small quantity remains encapsulated in a dense thickened pleura. Old encapsulation in the upper two-thirds of the lung field is more often posteriorly situated in the fossa near the spine and is usually distinctly circumscribed and small in area; the largest I have seen was the size of a small orange.

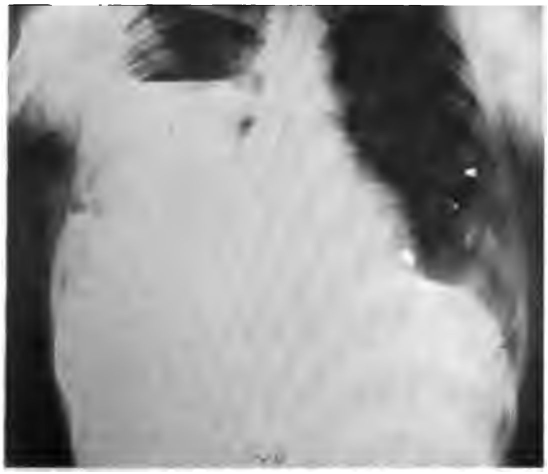

FIG. 20.
Lung abscess.

FIG. 21.
Lung abscess.

We have examined seven cases of broncho-pneumonia, complicating tuberculosis. In the advanced fibro-caseous type the differentiation is made comparatively without difficulty, particularly if both processes are observed on the same plate. Lung abscesses are comparatively rare and must be differentiated from encapsulated pleuritic effusion. In case of lung abscesses, if the patient is examined in the upright position, a fluid level is observed which maintains a level parallel with the floor when the patient flexes his body. There is seen usually a collection of air above this level. The same may be seen in pleuritic effusion, but such cases are not so likely to occur. Stereoscopic plates will demonstrate the central location of the fluid, as will the screen when the patient is viewed in the oblique position.

ROENTGEN-RAY PROBLEMS IN AN OVERSEAS NAVY BASE HOSPITAL

BY ROLAND HAMMOND, M.D.

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THE difficulties encountered in establishing the roentgen laboratory in U. S. Navy Base Hospital No. 4, located at U. S. Navy Base No. 6, Queenstown, Ireland, were of so instructive a nature that it seems worth while to place them on record for the benefit of those roentgenologists who may be required to establish such a laboratory at any future time.

This Base Hospital Unit was organized at the Rhode Island Hospital, Providence, R. I., in April, 1917, a few weeks after the declaration of war. At the request of the government, this unit was assigned to the Navy and was organized as a 250 bed hospital. The writer was asked to assume the duties of roentgenologist and orthopedic surgeon. The medical staff was limited to ten officers at the beginning but later was increased to 18 officers on the basis of a 500 bed hospital.

It was recognized early that the conditions under which roentgen-ray work would be performed in this war were vastly different from those of civil practice. The laboratory might be located under a tent near the firing line or it might be in an elaborately equipped base hospital, as well adapted for all kinds of roentgen-ray work as any civil hospital. All conditions must be provided for, since the operator very probably would be his own mechanic and electrician in case of trouble. Knowledge of machine construction, wiring and the ability to locate trouble are necessary qualifications of the roentgenologist working under war conditions.

The writer obtained the courteous permission of the Surgeon General, U. S. A., and the consent of the Surgeon General, U. S. N., and in July, 1917, attended the School of Military Roentgenology which had been established recently at the Cornell Medical College, New York.

Particular attention was paid in this course to machine wiring, repair of trouble without recourse to a professional electrician and the use of simple apparatus. The standard U. S. Army portable roentgen-ray outfit had just been put on a sound footing and already was being used in Army Base Hospitals overseas. At the School much emphasis was laid on the necessity of taking along one's own power plant, since the voltages in Europe were known to vary greatly. There was also the possibility of being assigned to some locality where electric current would not be available.

When the roentgen-ray equipment for this hospital was purchased in the fall of 1917, the writer presented these arguments to the U. S. N. medical officer who was charged by the American Red Cross with the purchase of all equipment for Base Hospitals. It was urgently insisted that only a portable roentgen-ray outfit should be purchased. With such apparatus one could always be sure of an adequate power plant. This portable outfit was adapted to all kinds of work except rapid gastro-intestinal roentgenography. The expense of establishing the roentgen-ray equipment at this base hospital has been conservatively estimated at about $5,000, whereas the portable outfit could have been obtained with necessary accessories for about one-fourth of that sum.

These objections were overruled and a 7½ K.W. transformer of standard type, operating on 220 volts A.C., was purchased. A complete equipment of accessories, including a table adapted for horizontal fluoroscopy, a stereographic tube stand, a

vertical fluoroscope, vertical plate changer, stereoscopic view box, eye localizer and dark room outfit was obtained. Some of this apparatus was unnecessary in a hospital of this character and was never unpacked. To allow for the possible necessity of adapting the existing voltage to the needs of this transformer, a rotary converter of 7½ K.W. capacity at 110 volts and an autotransformer capable of delivering up to 240 volts, 60 cycles A.C., were included in the equipment.

The Commanding Officer of the hospital was informed of the voltage requirements of the transformer and determined to secure a central heating and lighting plant for the use of the hospital and adjacent barracks as well. If this had not been accomplished no power could have been provided for the roentgen-ray plant. The nearest municipal supply line is a mile distant from the hospital and the voltage supplied is 220 D.C. An extension of this line could not be obtained since the capacity of the plant is only 50 K.W.

By good fortune, two 15 K.W. D.C. generators of 220 volts capacity each were purchased in England. These generators were belt-driven from two single-cylinder, high-speed, vertical type engines. These generators and engines were purchased largely with the view of furnishing power for the roentgen-ray laboratory. Otherwise, the entire heating and lighting plant would have been planned on a simpler and more economical basis. A 12 H.P. 220 volt D.C. motor was purchased—incidentally at a cost nearly approximating that of the Army portable roentgen-ray outfit exclusive of accessories—and belted to the rotary converter. The field of the converter was thus excited from the D.C. supply and 70 volts A.C. were delivered on the slip rings of the converter. By passing this current through the autotransformer about 240 volts A.C. were obtained. It was necessary to mount the transformer and the motor and rotary converter on separate concrete piers to prevent vibration. The rotary converter was wound for 110 volts and it was not practicable, with the facilities at hand, to rewind it for 220 volts. The small capacity of the converter was appreciated but it was considered probable that it would carry a sufficient current to operate the transformer to capacity.

On attempting to pass this converted current through the roentgen-ray transformer, it was found that the line voltage dropped to 180 volts or lower and that only 12 to 14 amperes could be obtained in the primary of the transformer circuit. The connections in the small synchronous motor transformer were changed so that it would operate on 200 volts, 50 cycles, and on 175 volts, 40 cycles, but no differences were observed in operating conditions. The maximum milliampereage which could be passed through the Coolidge tube circuit was 35 ma. with a back-up spark gap of three inches. Any attempt to raise the voltage at the tube terminals resulted in a lowering of the milliampereage.

Consequently an entirely different technique had to be developed. It was necessary to make exposures practically simulating those made with a portable outfit. By increasing the exposure time it was possible to obtain very good negatives of small parts and lungs. Antero-posterior views of the head and other deep parts were obtained only by the use of an intensifying screen and a very long exposure. Rapid gastrointestinal work was impossible with the equipment.

Electrical engineers and practical electricians from the repair ships stationed at this base were consulted and offered valuable suggestions and timely aid. Indeed, without their help it would have been impossible to operate the transformer. Their facilities and knowledge enabled them to make repairs and even design certain parts of the equipment which would not have been feasible in any other way. I wish to take this opportunity to express thanks to Lieutenant (junior grade) Harry Segel, U. S. N. R. F., for his advice and assistance. He designed a switchboard,

provided some accessory apparatus, worked out the wiring problems and instituted many repairs. As delivered, one of the connections in the motor circuit of the transformer was incorrectly made; one of the resistance units in this circuit was broken and the other burned out. The polarity indicator failed to work and the meters had to be overhauled.

The difficulties under which we labored could be overcome in all probability by rewinding the rotary converter for 220 volts; or another converter of 110 volts could be obtained and run in series with the first one. We should have adopted one of these expedients if the war had continued.

The experience with this roentgen-ray equipment demonstrates the importance of providing portable outfits with their own power plants for use in base hospitals which, for all practical purposes, are to be regarded as field hospitals. With such apparatus, patients unable to be moved to the laboratory can be examined in bed. If it seems advisable to provide a transformer and other equipment, such as are used in permanent hospitals, an adequate power plant should be provided with it.

COOPERATION OF ROENTGENOLOGISTS AND OTHER MEDICAL OFFICERS * †

BY MYRON B. PALMER

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ROCHESTER, N. Y.

IN EVERY department of medicine, cooperation with the roentgenologist and other physicians has but one meaning and that is "team work." It has been the experience of most physicians in their private practice or hospital work, that to obtain a sufficient amount of clinical data from the one who has studied the case is sometimes a difficult problem. Only in recent years have hospitals attempted to improve their clinical records and bring them up to a standard for future reference. There is, however, at the present time, a general trend toward hospital betterment and the establishment of a wider cooperation between their various departments. In other words, the establishment of medical conferences stimulates discussions and case study, for the betterment of all concerned.

In the past it might have been said that some hospitals were conducted largely for the benefit of physicians, with lack of consideration for the patients. While this may have been true in a limited sense, the model hospital of today is attempting to establish the widest cooperation of physicians, executives and patients, with the patient the primary object. With this in mind there can be but one solution and that is team work of the departments.

Civilian hospitals should be managed by competent, well-trained business men of wide experience, with the object of making the hospital a home for the sick and injured and assuming all financial responsibility of running the institution; knowing the needs of each department and making each department responsible and efficient. In a hospital thus conducted there is presented to the roentgenologist means of confirming his work by better cooperation with his consultants.

Roentgenology requires no comment as to its art. History will record the wonderful achievements in the recent great war made possible by the roentgen rays.

The roentgenologist is no longer the picture-making artist. He is a student of medicine in its widest sense. The further

* Presented at the Ninteenth Annual Meeting of The American Roentgen Ray Society, Camp Greenleaf, Ga., Sept., 1918.

† Permission to publish granted by the Board of Publication, Surgeon General's Office, Washington, D. C.

he advances in his art, the more of a clinician he becomes. He must know all branches of medicine thoroughly and continue to be a student. He must be a good clinician, a good pathologist and, moreover, a good anatomist. If he has not a special knowledge of the diseases of the bones and joints and the new growths, his work will be exceedingly difficult. A special knowledge of both the gross and microscopical pathology is of the utmost importance in rendering an interpretation. It is of great advantage to keep in touch with the clinical history that a thorough understanding of the case may be had.

It has been the contention of some roentgenologists that the case history either before or after the roentgen-ray examination is not desirable but that the diagnosis should be made entirely from the roentgen-ray findings. Others have desired the history only after an interpretation has been made, to aid in the final conclusion. However, recently, many roentgenologists have desired all of the clinical data available at the first examination so that any additional study may be made at the time, rather than have the patient return for future study.

In private practice it is often difficult to obtain the notes of the patient from the physician, except as he comes to consult concerning the roentgen examination. In hospital practice there should be no difficulty in obtaining the history. The consultant should have all the available data at the time of his examination and this can only be accomplished by thorough harmony and team work.

Errors have been made in the examination of the gastro-intestinal tract by mistaking the pressure of extra gastric tumors on the stomach wall for malignancy of the stomach, the nature of the tumor not being recognized by either the roentgenologist or the clinician, through carelessness in history taking, the absence of a blood examination (as in the case of a splenic tumor) or the forgotten urinalysis (as in a pancreatic tumor). Thus many instances are due to faulty team work.

The experience of the writer as a medical officer doing roentgen-ray work in a U. S. General Hospital has demonstrated that cooperation with the medical officers of the various departments is most essential. The roentgenologist who shows keen interest, willingness to consult, to demonstrate and to advise will be able to obtain clinical histories on request.

There is, however, an opportunity for improvement in this team work. This can be accomplished by holding weekly, or even daily, designated hours for consultation and interpretation of plates in the roentgen-ray laboratory; a means whereby each other's viewpoints of the case may be obtained. The roentgenologist who limits his field to only the plates before him for his conclusions in all cases is losing much valuable information and not gaining ground.

The request sheet for roentgen-ray examination in the medical department of the army, though somewhat small, conforms to the other history and hospital forms and for all practical purposes is sufficiently large to contain all the clinical history which the roentgenologist requires.

However, one obtains requests made out in the following manner: "Request: Examination of Mastoids." There is no history. Whether the condition is acute or chronic is not stated. Neither is the infected side specified, but as plates are made of both mastoids for comparison that may not be considered essential. But this is not satisfactory to the roentgenologist. The patient may have both ears plugged with cotton and the head bandaged. It should be the duty of the otologist to give you the information that this case has had measles with an infection of the middle ear. There are symptoms of right mastoiditis. The left mastoid was operated on ten weeks previously and has not healed. All this data is important when the plates are studied. We find it often difficult to differentiate between sclerosis from an old infec-

tion with extensive cell destruction and a very recent cell destruction. Then also we may wish to differentiate between a mastoid normally showing no well defined cell area or no pneumatic cells and a very old sclerosis.

Clinical data on any sinus infection helps greatly in clearing up doubtful cases of a chronic type.

As for the teeth, the dentist is more specific, depending on the tooth involved. It is necessary, however, for him to specify a certain tooth by the method as adopted in the "Army *X*-ray Manual." A request for teeth examination usually means all the teeth and should read so. If in search of some focal infection he should state arthritis of the knee, hand or ankle (as the case may be); "look for possible source of infection in the teeth."

Roentgen-ray examinations of the chest includes many things. It might mean a heart examination which in certain cases requires only a fluoroscopic examination and a single plate made at six foot plate target distance, for a teleroentgenographic report, while a study of the lungs for tuberculosis would necessitate the making of stereoscopic plates, in most cases. A study of the mediastinum requires plates made in oblique and lateral positions and it is likewise necessary to have specific instructions as to the method of procedure. While perhaps one might say that the careful roentgenologist, given a request for a chest examination, would fluoroscope with care the heart, mediastinum, esophagus and lungs and make plates in all directions, including the spine, yet time and expense are to be considered while more specific instructions and history would save both. Clinical data in certain cases stimulate further study for the roentgenologist without limiting him to certain routine methods. In making a request for a study of the lungs for possible tuberculosis it would be better to state "Examine for possible tuberculosis of lungs, suspicious area in upper or middle lobe or area, such as third interspace, nipple line, anterior. The clinical history is as follows: T. B. present, or absent, in sputum; excessive or no expectoration; evening temperature; loss of weight." The type should be specified, such as acute or chronic, active or chronic inactive. The experts on diseases of the chest may say that they can make a diagnosis of tuberculosis without the aid of the roentgen ray. The roentgenologist does not deny this, but if such be so, is it not proper that the clinician state his views of the case? Many are willing to take the roentgenologist's opinion. Therefore, the latter should have the opinion of the chest expert. The roentgenologist has not the time to devote to auscultation and to the taking of the history as it should be done; neither has the clinician time for the making of roentgenographs. The history of pneumonia and the complication such as empyema, pleurisy, abscess, should always be included. Do not leave out the occupation, as this is just as important. Lungs of coal and metal workers sometimes show confusing shadows, although to the trained eye of the roentgenologist they may easily be interpreted. While one in civil practice might have time to take extended clinical notes, the roentgenologist in a large active hospital, in either army or civil hospital work, finds no time for history taking. The roentgenologist who interprets the plates may not have made them or even have seen the patient.

The shadows of the pneumonias are frequently confusing and may resemble tuberculosis. The thin and dense radiating lines, the remains of an old pneumonia, may be all that is considered of importance in a suspicious T. B. chest and reference to the history may state that the case had pneumonia ten years previously.

The early stages of metastatic carcinoma of the lung are not always easily interpreted. The history of a breast tumor having been removed, even if one has no pathological report, is sufficient to excite one's suspicion. Pain, though often an unreliable symptom, may be misleading,

while notes taken by the attending surgeon or nurse may be of assistance.

The request for a heart examination without clinical data is common, yet how few wish to give a frank interpretation without some history. The roentgenologist wishes to know if the Wassermann was positive or negative. Perhaps much too frequently a mediastinal condition is called aortitis. Then there are cases in which a negative Wassermann will cause one to look for other cause.

The clinician who sends a patient with the request for an abdominal roentgen-ray examination is stating that you know more about the case than he does. A request for a stomach examination is not specific. He might have wanted you to examine the gall-bladder and as this was not mentioned, no preparation of the patient was made for gall-bladder study. The differential roentgen diagnosis between old gall-bladder disease and adhesions about a leaking duodenal ulcer may be difficult in some cases, while the clinical history may give the additional help in the final interpretation. Blood in the vomitus, blood in the stool, is of just as much value to the roentgenologist as to the clinician. If the patient has not made these observations the nurse no doubt has recorded them on the history chart. If a patient presents symptoms referable to the upper right quadrant, mention should be made in the request, stating that roentgen-ray study is desired of this region. Patient gives history of an old duodenal ulcer associated with gall-bladder disease. After a careful examination, one plate of a series may show gallstone shadows, while a request for a fluoroscopic examination of the stomach would have given negative findings. In a routine examination of the gastro-intestinal tract, the clinical history is essential to the roentgenologist and the one who fails to grasp every small bit of history is doing a great injustice to all concerned. Many careful roentgenologists in examining a patient presenting general abdominal symptoms, include in that examination the gastro-intestinal tract, gall-bladder, kidneys, ureters and bladder, as well as the spine. This is all very well and is most advisable in civil work or in clinics; but for the roentgenologist of a busy army hospital it is unnecessary.

A request for one kidney should never be complied with, but the entire urinary tract should be included. A plate showing an enlarged kidney outline may help one in suggesting that there is a hypernephroma or a pus kidney, and with the information that the urinalysis shows pus or blood, added confidence is given to the diagnosis. Yet the roentgenologist is seldom given this information. A case referred for gastro-intestinal examination but having symptoms also referable to the chest in which the fluoroscopic examination showed an old pneumothorax and negative gastro-intestinal findings, proves interesting to the roentgenologist but somewhat embarrassing to the clinician. While, had mention been made in the request to examine the chest, it would have avoided all suspicion on the part of the roentgenologist of any laxity in the clinician.

Carelessness of ward surgeons in not giving specific directions as to the possible locations of fractures, causes extra work for the roentgen-ray department. When a patient comes for examination with the request for roentgen-ray examination of fracture of the leg and his leg is covered with splints and bandages, it is easy to place on this bandage a pencil or ink mark and state on the request the designated area to be taken; yet this detail, though simple, is often neglected and the roentgenologist should not remove splints or bandages without the permission of the attending surgeon. If no careful examination has been made to determine the possible location of a fractured bone, it should be so stated on the request, and the roentgenologist will include a sufficiently large area to make certain that he has not overlooked a fracture. He should report the area examined, and if on a later inspection of the examining physician, the sus-

pected fracture is not in the area specified, the latter will return the case and not hold the roentgenologist responsible for failing to locate and report the fracture.

Of recent years the roentgen-ray study of diseases of bones and bone tumors or new growths has given to the literature much valuable information, and although the roentgen-ray plate gives in a general way a characteristic shadow which corresponds to a definite pathological classification, yet few of us wish to pin our faith to this classification without some clinical data.

As to stereoscopic plates and the request that such be made, this method of examination should as a rule be left to the decision of the roentgenologist, who should know whether stereoscopic plates will give better or more accurate information. Stereoscopic plates have great advantages over the single plate method for study and are often more essential than anterior, posterior and lateral views. But the request that stereoscopic plates be made in all cases of fractures, is unnecessary. It is seldom necessary to make stereoscopic plates in the simple fractures but for the proper adjustment of compound and badly comminuted fractures, the stereoscopic plates give the surgeon much added information that might not be available by the single plate. In such cases it is the duty of the roentgenologist to encourage the surgeon to view the plates before attempting operative procedure and if he so desires, to be present at the operation to give any added information which may be of value in the readjustment of fragments.

Fluoroscopy (with the use of the bedside unit in the operating room) may serve to assist the surgeon in the better reduction of fractures. This work would require little effort on the part of the roentgenologist, and it means cooperation and team work.

Now, that suggestions have been offered to the clinician, a little advice to the roentgenologist as to the report of his examination seems essential. The reporting of the roentgen-ray findings is an art and is tempered by experience. There is one word to emphasize and that is "conciseness."

Remember that the attending physician or surgeon is also busy and his opinion of the roentgenologist is not advanced by an extended report or detailed explanation of everything seen on the plate. He desires facts, clear, concise, to the point, so that in few words he may grasp your interpretation. Do not tell the surgeon or orthopedist that he should readjust a fracture. He may not consider it necessary. That point is up to him, but you can tell him how much displacement there is, that "the general line of position in the cast is not good," and give him the degree of displacement.

It is not the intent of this paper to criticise adversely, but to offer facts and suggestions with the prospect and purpose of stimulating better cooperation among roentgenologists and other medical men.

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MILITARY STIMULATION OF CHEST ROENTGENOLOGY

Roentgenology of the chest, with respect to both its medical and surgical aspects, has received much stimulation from the influence of diagnostic activities in military work. With the possible exception of the head and face, the thorax was the region which, more than any other, afforded great opportunities for the roentgenologist in war work. At the various camps and cantonments in this country he had such chances unnumbered, afforded by influenza and its attendant evils. Overseas, direct and indirect damage produced in the chest by projectiles was prodigious in amount. In such cases, the military roentgenologist in France could detach himself from the field of mere routine and, if time permitted and the spirit moved, could pursue almost unlimited research. The immediate and the more remote aberrations presented by lung and pleura were as great in variety as they were in amount; and with stereoscopy at his command, he was enabled not only definitely to aid the immediate efforts of the surgeon, but also later to assist the physician in his periodic observations of what are usually long and protracted cases.

The end is not yet, by any means. The pulmonary and pleural conditions which have been set up by the traumata of war, as well as by the damage of acute and chronic infections, will persist long after the more classic wounds of warfare have healed; and as civilians we shall continue to see them in our practice. Let us be prepared to embrace this new material as a basis for our future scientific studies.

PERCY BROWN.

ROENTGEN DIAGNOSIS OF LUNG DISEASES

Progress in the roentgen diagnosis of diseases of the lung, especially of tuberculosis, has always been retarded by a lack of cooperation between the clinician and the roentgenologist. The clinician has regarded the labors of the roentgenologist either with distrust or with child-like credulity, according to his bent. For this distrust there has unfortunately been some foundation. The fantastic diagnosis arrived at by some roentgenologists from a poorly exposed and developed plate made in the dorsal recumbent position at a distance of 20 inches, are not

likely to commend themselves to a clinician of experience. An antiquated and inexact terminology, which has no basis in the pathology of the lung, is used in making reports of the findings, and the mystified clinician, lost in the mazes of "peribronchial infiltrations" and "linear interweavings" wonders whether his patient has pulmonary tuberculosis or not. In the minds of many able medical men, an unwarranted scepticism has resulted, together with an unwillingness to grant to the roentgen examination the place in the diagnosis of pulmonary tuberculosis which its importance warrants. This finds its extreme expression in one of the latest and best books on diseases of the chest. I quote from Norris and Landis: "The latter (the roentgenologists) arrogate unto themselves an ability to recognize early tuberculous lesions in the lungs which is not warranted. In the first place the earliest manifestations of tuberculosis as shown on the roentgenogram, are not distinctive," etc. This quotation indicates an irritation—to some extent justified—at the extravagant interpretations often made of plates which reveal no abnormality, or merely a faulty technique. On the other hand, such a statement can be inspired only by the grossest ignorance of the demonstrated achievements of the roentgen ray in the field of thoracic diagnosis. In view of these circumstances, the opportunity afforded by our large military establishment for a study of large groups of men by standardized roentgen methods is a matter for congratulation. Such study, and its correlation with the results of clinical examination, cannot fail to clarify our ideas as to some fundamentals of thoracic diagnosis.

Too much has been said and written in the past on the subject of root changes and hilum tuberculosis. It can be justly laid at the door of the roentgenologist that he has popularized the notion of hilum tuberculosis, which has no basis except an erroneous interpretation of his plates. He has thus fostered the conception of an extension of the tuberculous process from the root to the periphery along the peribronchial tissues, a conception which in the vast majority of cases is opposed to the facts of pathology. An emphasis, entirely unwarranted, has been placed on an exaggeration of the radial markings of the lung, to which has been attributed so great a significance in the diagnosis of pulmonary tuberculosis. It is gratifying to note, therefore, that in the reports of extensive roentgen examinations in some of the base hospitals in France, minor importance is assigned to these so-called peribronchial infiltrations, so that by themselves they are not considered an evidence of tuberculosis. The diagnosis of tuberculosis must be based on definite discrete shadows, which begin usually in the periphery of the lung and have no necessary relation to the bronchial tree.

Unquestionably to disclose such shadows presupposes a good plate. One cannot too deeply deplore the tendency, now so prevalent, to attribute a superior, almost a magic virtue to a set of stereoscopic plates of the chest. It is assumed (and it is considered heresy to question the assumption), that stereoscopic plates will supply us with information beyond the scope of the single plate. As a result, the production of excellent single plates is neglected; inferior stereoscopic plates are the vogue, and critical study gives way to phantasy and an optical illusion. It is needless to add that in certain conditions good stereoscopic plates are of material assistance in making a diagnosis, and sometimes are the only means of arriving at a correct one.

It is an unfortunate thing, one which has delayed the universal recognition of the roentgen ray in chest diagnosis, that a controversy still exists as to the relative value of fluoroscopy and radiography. Each undoubtedly has its own field of usefulness and both of them should form a correlative part in any complete examination. Without entering into the merits of the question at this time, there is no doubt that in the rapid examination of large

number of men fluoroscopy is of supreme value. In a rough way it may be stated that in such a rapid examination the clinician looks for râles, while the fluoroscopist seeks infiltrations. The work of the roentgenologist has wider scope, as he determines the actual presence of tuberculosis, while the physical examiner seeks evidence of its activity. It is no wonder, therefore, that he succeeds in discovering a greater number of cases of pulmonary tuberculosis, especially those cases which are latent. This has been the experience in the army camps where rapid work was essential and consequently physical examination suffered in precision. The fluoroscope reveals at a glance the existence of an infiltration, and it must remain a valuable adjunct in checking up tuberculosis in large groups of men. It is not disparaging to the clinician to affirm that a careful fluoroscopic examination sets the seal of certainty on his positive or doubtful cases, and not uncommonly leads to a revision of his negative ones.

H. WESSLER.

COMMUNICATION FROM THE COUNCIL OF NATIONAL DEFENSE

The Council of National Defense authorizes the following:

Early in February each physician in the United States exclusive of those who served in the Medical Corps of the Army for the past two years and members of the Volunteer Medical Service Corps, received a communication from the Council of National Defense, requesting that he fill out and return promptly to the Washington office an accompanying questionnaire, so that there may be on file in Washington complete individual information covering the members of the profession. Simultaneously with the distribution of these questionnaires, state and county representatives of the Volunteer Medical Service Corps were instructed to urge all doctors in their communities to comply promptly with the request of the Council to fill out and forward promptly to Washington the blanks sent them; and to advise those who by any chance failed to receive blanks, to communicate with the Council of National Defense at once in order that application blanks might be furnished them.

The Volunteer Medical Service Corps was organized early in 1918 to serve the Government during the emergency of war. As this emergency has ceased to exist, active membership in the Corps is no longer solicited. However, the survey initiated by this organization last year has proved of such value as a source of information concerning the individual members of the medical profession that the Surgeons General of the Army, Navy and Public Health Service have requested the Council of National Defense to complete it so as to include every doctor in the country, in order that a permanent record of the profession may at all times be available for reference in future emergencies. Upon their completion, the records will be transferred to the Surgeon General's Library where they will be kept up to date by a force assigned for the purpose, and be accessible to all government bureaus.

Every physician is requested to cooperate with the Council of National Defense in making this record complete by returning at once the questionnaire received or by writing to the Medical Section of the Council of National Defense, Washington, D. C., and requesting that a blank be sent him if through an oversight he did not receive one.

TRANSLATIONS & ABSTRACTS

Block, E. Bates. The Relation of Oral Sepsis to the Nervous System. (*South. M. J.*, Nashville, Vol. XI, Sept., 1918, p. 606.)

The importance which oral infection plays in nervous diseases is due chiefly to the fact that it is the most frequent situation of focal infection. One of the nervous diseases which has been attributed directly to oral sepsis is neuralgia of the superior or inferior dental branches of the trigeminal nerve. Oral sepsis is not a cause of trifacial neuralgia of the type known as tic douloureux. Cases reported of apical and alveolar abscesses causing mania, melancholia, dementia precox, and hysteria major, need the confirmatory evidence of a greater number of cases before definite conclusions can be drawn. But although it may not be the only etiological factor, oral sepsis, like focal infections in any other part of the body, produces general nutritional disturbances, anemia, and toxic states in which the nervous system suffers like the other organs in the body. An exhaustion psychosis may follow prolonged suppurative conditions of the teeth. The same may be said for neurasthenia, psychasthenia, hysteria, hypochondria, and other functional neuroses; but it is not so potent a factor in the production of these as are diseases of the abdominal and generative organs. The relation of pyorrhea alveolaris and epilepsy is worthy of further study. The relation of oral diseases to distant lesions of nerves that supply the infected regions is commented on, following the report of cases in which this relation was indicated. It would be interesting to know what percentage of cases of bulbar paralysis show oral sepsis.

Goitre has been observed associated with either tonsillitis or pyorrhea alveolaris, but this probably represents merely a lymphatic or neighborhood toxic enlargement. Chorea is not due to tonsillitis except in so far as it forms only one of many points of focal infection in this disease. Both the tonsillitis and the chorea are due to the same germ. Good results are seen to follow the removal of the tonsils between attacks of chorea, and the same results follow the removal of subcutaneous fibroid nodules. Other observations report cases that did no better when the tonsils were removed than others in which they were not removed.

The tonsils may form the nest from which bacteria go out and fortuituously produce disease (depending upon where they lodge) in the ganglia of the sensory roots of the cranial or spinal nerves with a predilection for herpes facialis or labialis rather than herpes zoster, or the infection may invade the medulla, producing bulbar paralysis, or the spinal cord, producing myelitis. Herpes zoster or spinal myelitis, if due to oral sepsis, must be explained on a hemogenic theory.

The mere removal of the focal infection does not necessarily cure the secondary disease, as the infection may have extended beyond the point of the focal infection, and the best results are obtained by the prophylactic effect of the removal of the focal infection, or by the toxines from the point of focal infection.

Roberts, Stewart R. Discussion—Symposium on Oral Sepsis. (*South. M. J.*, Nashville, Vol. XI, Sept., 1918, p. 609.)

It is necessary to examine each tooth separately and individually and to compare that tooth with its fellow on the opposite side. Dead teeth, crowns, and bridges are to be suspected. There is a catarrhal gastritis, occurring chiefly in young women, in which the three chief symptoms are: belching, anorexia, and epigastric pain due to an oral sepsis. Free drainage is necessary and possibly explains why there is not more extraoral pathology. Gastric ulcer has been thought to be due to certain probable causes, and while it is one thing to have oral sepsis, it is another thing for all sepsis to cause extraoral pathology.

The *x*-ray man per se is a medical photographer, and the diagnosis and quick judgment should be left to the dentist, the physician, and the surgeon.

Paullin, J. E. Discussion—Symposium on Oral Sepsis. (*South. M. J.*, Nashville, Vol. XI, Sept., 1918, p. 609.)

It is difficult to determine in the great majority of cases whether or not there is oral infection, particularly in the molar teeth of the

upper jaw, especially of the last two molar teeth of the upper jaw. Oral infection does not necessarily mean that it is the cause of the particular complaint from which the patient is suffering. It is a question whether or not anything short of the extraction of a tooth with a marked periapical infection, and with an osteomyelitis, followed by the curettement of the focus, will do any good. In some cases amputation of the roots followed by curettement has completely removed the infection, to judge by subsequent ray examination. But in other cases teeth treated in exactly the same way have not recovered, and the focus of infection still remains. Because a man has an infected tooth, extraction does not necessarily follow. The patient should be sent to a competent dentist for treatment and decision.

COOLIDGE, EDGAR D. A Discussion of the Responsibility of the Dental Profession in the Diagnosis and Treatment of Conditions in and about Root Canals. (*Dental Items of Interest*, Vol. XL, July, 1918, p. 515.)

Where a vital pulp is to be removed, a roentgenograph should be taken to reveal the condition, number, size, and direction of the root or roots. Where a root is very crooked or constricted, the pulp should be retained if this is at all possible. In interpretation of periapical involvement, it is difficult to determine the exact extent of absorbed bone. It is difficult in some cases to determine whether such an area is partly caused by the normal bone canals and foramina, or whether it is pathological; and it is possible to overlook such an area where a very heavy plate of bone exists, on both labial and lingual sides. There may be definite evidence in the roentgenograph of an area or cavity and the tooth over it may contain a vital pulp. Clinical evidence is necessary.

PRICE, W. A. Abstract of Discussion on Chronic Mouth Infections in their Relation to General Diseases. (*J. Am. M. Ass.*, Vol. LXVII, Sept. 16, 1916, p. 854.)

Devitalized teeth must be extracted. Researches in the Research Institute of the National Dental Association have not been able to sterilize one single canal; medicine used included sulphuric acid and formalin and others not to be used in ordinary conditions which were used as part of the experiment. The area beyond the tooth apex cannot be sterilized by any means, but dentists can so change the balance of safety for the patient that nature may have a chance to destroy the reduced infection.

BYRON C. DARLING.

UHLER, H. S. The Geometry of Image Formation in *X*-ray Analysis. (*Phys. Rev.*, 11, Jan., 1918, pp. 1–20. *Science Abstracts.*)

The paper deals with the general theory upon which the construction of x-ray spectrometers and spectrographs should be based. General equations are derived for the incident and reflected rays, and it is shown that in general not more than two rays can be constructed when one point on the incident segment, one on the reflected segment and the glancing angle are given. The following theorem of the focal circle is proved in a perfectly general manner: all rays lying in a plane perpendicular to the axis of rotation of a plane selective mirror—the axis coinciding with the mirror (pure rotation)—and radiating from a single point will, after reflection, pass through two focal points each of which is at the same distance from the axis as the radiant point, the angles of deviation of the axial or principal rays of the pencils being numerically equal to twice the constant glancing angle. This fundamental theorem is not new as demonstrations of it involving only elementary non-analytic geometry have already been given by Bragg, Wagner, and others. The theorem involves the following assumptions: (*a*) The rays of a pencil must all lie in one plane perpendicular to the axis of rotation of the crystal, (*b*) the rays must not penetrate the crystal to a finite depth, (*c*) the reflecting plane must contain the axis of rotation, and (*d*) the slit must act as a mathematical line source.

It is shown analytically that a circular envelope arises when the reflecting plane is parallel to the axis of rotation but does not contain the axis. Special properties of this locus are demonstrated. Rays having finite angular altitude produce asymmetric broadening of the spectral images even when the azimuth is zero. When the angular altitude is constant and the azimuth is finite and variable, the bundles of rays have astigmatic properties.

This broadening is always in such a direction as to lead to too large a value for the glancing angle. The effect of tilting the reflecting planes of atoms with respect to the method [Abs. 666 (1914)] was again used. The various modes presented by the secondary lines are shown diagrammatically. Besides these a number of lines show a considerable broadening toward the red side in strong fields. The wave-lengths of these seven broadened lines range from $\lambda 446.1$ to $\lambda 4764.0$, and in all cases the *s*-component shows the effect, while with $\lambda 4511.9$ and $\lambda 4764.0$ the *p*-component is also broadened. Including the broadened lines, 15 affected lines have been discovered besides the 17 given previously [Abs. 955 (1917)]. It was noticed that the outer components of the Balmer lines often extended beyond the unaffected neighboring lines belonging to the secondary spectrum. According to Stark, the carriers for the Balmer lines are the positive atomions, while those of the secondary spectrum lines are the neutral hydrogen atoms. From the effects now observed it seems very probable that the Balmer lines and those of the secondary spectrum are due to different carriers, as there appears to be no mutual influence between them. A. W.

Ulrey, C. T. Energy in the Continuous *X*-ray Spectra of Certain Elements. (*Phys. Rev.*, 11, May, 1918, pp. 401–410. *Science Abstracts.*)

The continuous *x*-ray spectra of Pt, W, Pd, Mo, Ni, and Cr have been investigated by the *x*-ray spectrometer method as developed by W. H. and W. L. Bragg [Abs. 1830 (1913)]. By comparison of the areas and max. ordinates of the radiation curves of the above elements it appears that the energy emitted in the form of *x*-radiation in this part of the spectrum is not directly proportional to the atomic weight or the atomic number, but is a periodic function of either, the periodicity coinciding with that of the chemical periodic system.

The continuous spectrum of tungsten has been examined over a range of voltage from 20 to 50 kilovolts. Within this range the following relation between the wave-length of max. energy, $\lambda_{max.}$, and the voltage is found to hold: $\lambda_{max.} V^{1/2} =$ const. The areas under the tungsten radiation curves are proportional to the square of the voltage between 25 to 40 kilovolts.

A. B. W.

Faxen, H. Scattered *X*-radiation due to Heat Motion of the Molecules in Crystalline Reflection of *X*-rays. (*Ann. d. Physik*, 54. 8, April 26, 1918, pp. 615–620. *Science Abstracts.*)

In a paper on "Interference of *X*-rays and Heat Motion," P. Debye calculated the effect of heat motion of the crystal molecules on the reflecting properties of the crystal [see Abs. 1078 (1914)]. The author now calculates, as a direct consequence of Debye's work, the extent of the scattering produced by heat motion. In general, his results are in agreement with Debye's; but it is also shown that the scattered radiation reaches its maximum value in the neighborhood of the interference maxima—in which case Debye's formula for scattering no longer holds. A. B. W.

Dershem, E. Resolving Powers of *X*-ray Spectrometers, and the Tungsten *X*-ray Spectrum. (*Nat. Acad. Sci.*, Proc. 4, March, 1918, pp. 62–65. *Science Abstracts.*)

From simple considerations of crystal reflection the author shows that the resolving power of a given crystal may be expressed as follows:

$$\lambda/\Delta\lambda < nr\lambda/[d \cos\theta \, (s + 2t \cos\theta)],$$

where λ is wave-length of *x*-radiation reflected at the angle θ, d the "grating space" of the crystal, s the width of the *x*-ray beam, t the thickness of the crystal, and n the order of the spectrum.

From this expression it appears that the resolving power may be increased by increasing the order of the spectrum and the distance between the crystal and the photographic plate, and also by decreasing the width of the source and the thickness of the crystal. To increase the resolving power by any of these means results in a loss of intensity which must be compensated for by an increased time of exposure.

Using a Coolidge tube, with tungsten target, and reflecting from a rock-salt crystal the author has made a series of careful measurements of the wave-lengths in the *x*-ray spectrum of tungsten. The results, which are tabulated, are claimed to be accurate within 0.1% in the case of L-radiations and 0.8% in the case of K-radiations. In the case of the L-lines the resolving power, as defined above,

was less than 170, but nevertheless 19 separate and distinct lines were obtained. A. B. W.

HALL, E. H. Thermal Conductivity in Metals. (*Phys. Rev.*, 11, April, 1918, pp. 329–330. Abstract of paper read before the Am. Phys. Soc., Dec., 1917.)

It is generally admitted that there are free electrons in the interatomic spaces of a metal and that their number increases with temperature. Hence there must be, in a detached metal bar hot at one end and cold at the other, a mechanical pressure tending to drive the free electrons down the temperature gradient. If this tendency prevails, even to a slight extent, it makes the hot end of the bar electrically positive and the cold end negative. It is then argued that the electrons will function somewhat like a vapor, and will absorb heat at the hot end and will give it out at the cold. A few numerical data are given in support of this idea. E. H. B.

JACKSON, CHEVALIER. Acromegaly of the Larynx. (*Journal A. M. A.*, November 30, 1918.)

The writer describes four cases of acromegaly in which the structures of the larynx participated in the enlargement. He points out the very slight attention which has been given to the condition of the larynx in acromegaly, especially in view of the frequency with which changes are noted in the voice, and emphasizes the need for examining the larynx in every case. The overgrowth of acromegaly involves the laryngeal cartilages and soft parts and may produce stenosis sufficient to require tracheotomy to prevent asphyxia. The laryngeal image seems frequently to be asymmetrical, though the external enlargement is usually symmetrical upon palpation. The altered voice of acromegaly may be due to the laryngeal changes; alterations in the resonating cavities, etc. Acromegalic overgrowth should be excluded in all cases of apparent laryngeal hyperplasis.

DEUTSCH. *X*-ray Diagnosis of Syphilis. (*Centralblatt für Chirurgie*, 1918, Vol. XLV, p. 313.)

This is the case of a man aged twenty-six who suffered from dyspnea, cough, and a high temperature. He stated that at times, he coughed up blood. The roentgen ray examinations showed anteriorly that the left apex was indistinct, posteriorly, shadows obscured both apices. In the right lung there were isolated patches. The hilus was sharply outlined. On the left, there appeared on dorsoventral transillumination at a corresponding level with the lobes, a deep linear shaped shadow, the apex of this shadow being directed toward the hilus and pointing outward. The lower portion of the lung was obscured. There was little movement in the diaphragm, and the left of the heart was obscured by shadows. The aorta seemed normal and lying in a free mediastinum. On inspiration, the mediastinum did not seem to be dislocated into the healthy half of the thorax upon sagittal transillumination. Tubercle bacilli were not discovered. A positive Wassermann reaction was found. The patient showed a marked improvement under mercurial treatment which was followed by a change for the worse and a distressing cough. He expectorated foul smelling greenish masses of mucus which seemed to come from the lower air passages and to relieve his inspiratory stridor. He suffered from dyspnea, his respiration was superficial, and he was hoarse. A second roentgen-ray examination showed that in the earlier dense shadow in the center over the base of the left lung, was a nuclear shaped area of clarity and this appeared more like a retiform structure whereas the balance of the lung remained the same as before. The patient died. The postmortem findings showed that the roentgen ray should have been interpreted as follows: The central wedge shaped shadow corresponded to the thick layer of pleural inflammation in addition to the thickened bronchial walls and the secretion filled cavities. When part of the secretion in these cavities was removed by coughing, as a result of the treatment, the shadow became more clear. On account of its position along the lowest portions of the upper lobe, the picture shown resembled that of an interlobular exudate which was distinguished principally by its form with the base turned toward the hilus. The shape of these shadows appears to be characteristic of the most usual form of pulmonary syphilis. It may also furnish an indication in making a diagnosis. The pleural affection is usually present at an early period of the pulmonary fibrosis. Treatment should begin early if the condition is recognized.

Schreiner, Bernard F., Simpson, Burton T., and Mueller, Theodor, Buffalo, N. Y. Diagnosis and Treatment of Basal Cell Epithelioma, with the Report of 59 Cases. (*Am. J. Surg.*, January, 1919, Vol. XXXIII, p. 1.)

"This is Harry H. Hagen's classification, in his book on 'Skin Cancer,' of basal cell epithelioma:

1. Flat rodent ulcer.
2. Nodular epithelioma.
3. Rolled edge epithelioma.
4. The depressed scar-like cancer.
5. Morphea-like.
6. Fungating epithelioma.
7. Deep ulcerating.

"As the basal cell epithelioma of the skin is a superficial tumor, it, therefore, does not seem difficult to destroy all cancerous tissue and thus obtain a permanent cure. Even rather advanced cases are amenable to treatment. The infrequency of metastases increases the chances for a permanent cure, yet in spite of this there are among our cases many who had previously received medical attention without success. *X*-ray, caustics, and the thermocautery had been used or the tumor had been removed surgically. The effect was either a speedy recurrence after temporary healing, or a more rapid extension of the lesion.

"For the treatment in our cases we used the following procedures, either alone or combined: fulguration, excision, radium and *x*-ray treatment.

"Fulguration has only a local effect which is practically the same as cauterization or coagulation of the tissue. It does not possess any advantage over the thermocautery in the treatment of basal cell epithelioma. We treated only two cases with fulguration. One of them healed promptly within 23 days, the other was fulgurated several times but remained stationary and healing at last was obtained by radiation.

"Six basal cell epitheliomas were excised. All patients so treated were healed and remained well, some of them for more than three years. This success may be explained by the fact that we operated only on carefully selected cases. Not all cases, owing to their size and location, can be dealt with surgically.

"In 19 cases we applied radium. We used it in the form of radium bromide, of which 51 mgs. were applied in metal applicator. In 9 cases the treatment was successful and a clinical cure has been obtained. One of these cases, however, sustained a severe radium burn which healed only after eight months. In another case of this group it is doubtful whether the success can be ascribed to the effect of the radium alone. This patient with an ulcerated lesion on his nose had been fulgurated twice without success. Then he received within sixteen days two mild erythema doses of unfiltered *x*-rays, whereupon his lesion showed considerable improvement. Eight days after the last *x*-ray treatment, before the full effect of the *x*-rays had time to develop, the ulcer was radiated for three hours with radium. It is, therefore, not improbable that this lesion might have healed without the radium application. The favorable influence of the radium rays in the successful treatments could usually be noticed after two weeks, while it took from 1–2 months from the beginning of the treatment until the lesion had disappeared. One patient is still under treatment, almost well. In the nine remaining cases the radium treatment did not prove satisfactory. Some of these showed at first some improvement, but then remained stationary; in one case the ulcer even progressed. Three of these cases which were refractory to radium were later on treated with *x*-rays and were healed promptly. On the other hand, among these nine cases were four which had not responded to many applications of the *x*-rays and which also could not be influenced by radium. Our success with radium in basal cell epithelioma (50%) is, therefore, not very encouraging. Perhaps the amount of radium at our disposal is not sufficient for all cases, though it was large enough to produce a burn; perhaps we have not yet found the proper technic as to the filtration and doses of the radium. It is also possible that the failure of the radium treatment in some cases is due to the quality of the radium rays; their wave-length is probably too short and their penetration too high to be sufficiently absorbed by the tissue.

"Fifty-four cases have been treated with *x*-rays. They can be divided into two groups. The first group contains thirteen cases which were treated with fractional filtered and unfiltered *x*-ray doses of varying penetration. Most of these cases showed a slight erythema; four of these thirteen cases remained refractory after temporary improvement. The other nine

cases were pronounced clinically well within 3–10 weeks and are well at this time.

"The second group contains forty-one cases, eleven of which are still under treatment. With these the object was to destroy, if possible, with a single erythema dose all carcinomatous tissue. All were ulcerated, and in all the ulcerated lesion healed. In only one instance the scar remained slightly elevated. It is to be regretted that this patient did not report for further observation and treatment. All other cases (97%) healed with scars that were quite satisfactory from a cosmetic point of view. The deliberately produced erythema of the skin did not inconvenience the patient in any way and disappeared after 2–3 weeks. The first improvement was usually noticed 1–2 weeks after the application of x-rays. The time required for healing varied between 3 and 6 weeks and depended upon the size of the new-growth. The time necessary for healing was prolonged somewhat in two patients who suffered from very extensive tumors which had already invaded the deeper layers of the subcutis.

"The difference between these two groups is too great to be overlooked and speaks decidedly in favor of the so-called 'massive dose treatment,' which consists of few rather powerful applications, as recommended by MacKee and Remer and by Pusey. The treatment with frequent small doses, the so-called 'fractional dose' method, originated from the idea that it would not damage the healthy skin and tissue overlying the tumor. Of course it is absolutely necessary to pay strict attention to the skin when giving the so-called 'deep x-ray treatment,' but the basal cell epitheliomas of the skin are more or less superficial tumors of the cutis and subcutis that ulcerate and, if not cured, will destroy the skin progressively and much more thoroughly than it could ever be damaged by two or three erythema doses given at intervals of 3–4 weeks. It is a well-known experience of all who treat neoplasms with x-ray or radium that tumors may become resistant against radiation by the application of many small doses and then will continue their destructive growth uninfluenced. We have several such cases in the first group of our x-rayed patients. In our opinion the risk of underdosing when treating with x-rays is usually very much under-rated. The consequence of underdosing in a skin epithelioma is much more serious than a marked acute erythema of the skin that disappears in 2–3 weeks without leaving any trace. It is, moreover, not at all impossible that the hyperemia of the skin produced by the erythema influences favorably the progress of healing. Though we know very little at present about the mechanism of healing after x-ray treatment, it is conceivable that besides the destructive effect of the rays on the cells, cytolysins which are present in the blood may play an important part. From this point of view a deliberately produced hyperemia may therefore increase the direct effect of the x-rays. We can absolutely limit the effect of the rays to the smallest possible area by using proper diaphragms and by covering the surrounding skin with sheets of rubber impregnated with lead. The only danger is that we may choose too small an area, the consequence of which will be a recurrence.

"When treating skin epitheliomas, as a rule, we do not use any filter, so that all rays may be brought to bear upon the lesion. The hardness of the rays, which depends upon the hardness of the tube, and which can be changed at will when a Coolidge tube is used, varies in our treatments according to the depths in which the rays shall be absorbed. The effect of the rays is probably greatest in those tissue layers where they are absorbed, not in those which they penetrate. For tumors in the cutis and superficial layers of the subcutis we use rays of 3–5 Benoit penetration. In large fungous tumors we use rays of 6–8 Benoit penetration.

"When treating according to these principles, many of our patients required only one erythema dose for a clinical cure; some rather advanced tumors required repeated radiation, which was given at intervals of about three weeks. In one case of an unusually large fungous tumor we repeated the erythema dose at intervals of a few days to two weeks until the epithelioma undoubtedly showed signs of regression. No damage to the skin was done, special care for its protection having been taken.

"A comparison of the different methods of treatment which we used gives the following result:

Excision	100%	clinical cures
Radium application	50%	" "
X-ray application		
fractional dose method	69%	" "
massive dose method	97%	" "

The highest percentage of clinical cures has been obtained by surgical procedure and by heavy *x*-ray treatment, both of which a patient can get everywhere without great expense.

"When shall we advise a patient to be operated? When shall we apply *x*-rays?

"The excision of a basal cell epithelioma is usually only a minor operation which can be made under local anesthesia. If done aseptically the wound heals within 8–10 days with a linear scar. The condition essential for such a perfect result is that we can operate within healthy skin and yet have sufficient skin to close the defect. It is the consideration of the cosmetic effect which so often causes the surgeon to fail to reach the safety zone. Sometimes the localization of a basal cell epithelioma is unfavorable for excision, e. g., the nares, the tip of the nose, the nasolabial grooves. That our percentage of clinical cures is higher with operative treatment than with *x*-ray treatment is due to the fact that we only operated on carefully selected cases while cases were admitted to *x*-ray treatment just as they came in, whether beginning or advanced.

"It is an advantage of the *x*-rays that they can be applied on all parts of the body surface and against lesions which are so far advanced as to be inoperable. The time necessary for healing is decidedly longer than that with an operation, but the chances for complete success are much greater. Almost unconsciously we expose to the *x*-rays a much larger area of healthy skin than we would excise in an operation. In order to excise all malignant tissue which *probably* may exist in the neighborhood of lesions, we usually have to sacrifice large portions of healthy skin, while, when using *x*-rays, the healthy skin which has been exposed to the rays remains intact and yet all malignant tissue beneath it has been destroyed.

"There is one dangerous feature in *x*-ray treatment of skin epitheliomas, and that is the tendency toward underdosing. As long as we treated with numerous small *x*-ray doses the percentage of our clinical cures was only 69% and we saw a few cases become refractory against the rays. On the other hand since we instituted massive dose treatment we have had 97% of clinical cures and we have not met one basal cell lesion that was refractory. Among our patients were quite a few who had had *x*-ray treatment elsewhere without success and who only reluctantly submitted to a renewed *x*-ray application. One or two erythema doses were sufficient in every one of them to produce a clinical cure. At present we no longer operate basal cell epitheliomas except for purposes of research. We treat them with erythema doses of *x*-rays and are well satisfied with the clinical results. When we emphasize the danger of underdosing, we do not mean, however, to recommend a reckless indiscriminate radiation of skin cancers with the causation of severe burns. What we advocate is the application of such doses of *x*-rays as will secure the maximum destructive effect on the cancer cells and yet do no permanent injury to the skin. This dose has been reached with our machine and our treatment tube when a simple erythema of the surrounding skin appears after a few days. It is true that this massive dose treatment can only be given by experienced radiologists, who are well acquainted with the output of their *x*-ray equipment and know the erythema doses of their individual tubes and for the different kinds of rays.

"We know well, of course, that a clinical cure is not yet a permanent cure. As to the length of time which must elapse after a clinical cure has been obtained and before a permanent cure can be pronounced, opinions differ widely. Experience shows that the closer all cases of epithelioma with clinical cures are followed, the more this period of observation must be prolonged. Without entering into a discussion of this difficult question, it does not seem improbable that in explaining especially later recurrences, not only anatomical local factors (incomplete destruction of the lesion) have to be considered, but also the resistance of the whole organism against the development of malignant neoplasms. More recent researches into the etiology of cancer seem to indicate that in the development of cancer, besides local factors as chronic irritation, chronic infection, misplaced cells, etc., a more general change in the cell-metabolism of the whole organism also plays an important part. This, too, holds true for the basal cell epitheliomas of the skin, and makes us hesitate to pronounce a permanent cure, even after years of observation. Moreover, the multiplicity of primary basal cell tumors in an individual is an established fact. Such a microscopic primary focus may be present and be unnoticed in the neighborhood of a larger lesion and escape

treatment. It continues to grow and will later cause an apparent 'recurrence.' As basal cell tumors are usually of exceedingly slow growth this may take years.

The period of observation of our patients varies between several months and 3½ years. For pronouncing a clinical cure it is not sufficient that an ulcerated lesion is simply healed over. One of our patients had a small ulcerated epithelioma in the cheek. It was treated with many small x-ray doses without success, but healed over after two applications of radium, leaving a slightly elevated scar. During months of observation this scar did not show any sign of clinical recurrence. For reasons of research the scar was excised and we found beneath the new formed skin some still malignant tissues of basal celled type. Very often slight elevations or thickenings remain at the site of the healed lesion. These thickenings have, therefore, to be looked at with the greatest suspicion and the treatment has to be continued till they have absolutely disappeared. With this precaution, a recurrence will be very exceptional. We have at various times excised such scars and examined them microscopically, and have never found any sign of malignancy."

LIPPMAN, C. W. Communication on Postinfluenzal Empyema and Lung Abscess. (*Cal. State Medical Journal*, Feb., 1919.)

On the Stamford male service in San Francisco Hospital, 23 lung abscesses or empyemata were definitely studied which could be ascribed to influenza in the months of October and November. The four factors which are essential to the early diagnosis of these conditions are:

1. Toxic appearance of the patient.
2. Temperature averaging over 100 during the second and third week of the disease.
3. Persistent leucocytosis of 12,000 and over.
4. Roentgen ray findings.

The physical findings are regarded as of little value.

The roentgen ray findings were of exceeding importance in differentiating pneumonia from fluid.

HEISE, SAMPSON. *X*-ray on Pulmonary Tuberculosis. (*N. Y. State Med. Journal*, Vol. 17, No. 11, p. 429.)

The normal x-ray appearance of the lungs is very ably described. A description of the early stage of tuberculosis follows:

"Within the lung fields proper there are changes to be seen which readily tell the experienced observer that some form of pathology exists. These changes are essentially of two distinct physical characters, distinct as to distribution and shape. The first of these changes is characterized by the linear arrangement along the course of the bronchi and blood-vessels of small nodules or somewhat circular shadows. In size they may vary from one millimeter upwards. They appear separate and distinct and give rise to the impression of beading along the ramifications. At times they appear with rather clean-cut margins, but at other times their margins as well as the margins of the pulmonary ramifications appear hazy and fuzzy. They may occur anywhere along the course of the blood-vessels and bronchi, which appear to be accentuated in density. To be of use in diagnosis they should not be considered when in the immediate vicinity of the roots.

"In mottling, which is an early stage, the tubercles are not arranged linearly, nor do they follow a definite outline. Between them is an area of lesser density suggesting patchiness. In addition to the above changes the fan-shaped density of Dunham is described. The dense spots seen in most plates are regarded as evidence of an early tuberculous infection which is healed. In the active stage the tubercles are surrounded by an area of inflammation. This area is shown by the x-ray as faint density surrounding the tubercles and causing their margins to appear fuzzy or hazy.

"When the tubercles have become more confluent, and caseous broncho-pneumonia is present—an exudative type of active lesion, this is seen as a more or less dense shadow with irregular fuzzy outline and in which there are no individual tubercles visible."

In the healing lesion this sign of inflammation disappears:

"In the healing lesion collateral inflammation disappears. The margins become more definite and the tubercle more dense, since it becomes fibrotic or calcareous. The area of patchiness of the caseous broncho-pneumonia loses in density, individual tubercles appear, hazy outlines are lost, and the individual tubercles undergo fibrosis or calcification, while the pulmonary

ramifications in the vicinity become more definite and distinct as they become more fibrous. . . .

"So then, although there are certain indications in the x-ray plate which would lead us to believe that a focus is active or healed, it would be quite unwarranted and unsafe as a general thing to make a corresponding diagnosis from the plates alone. However, when serial plates are taken at various intervals much knowledge can be gained as to the progress of the disease in the individual. . . .

"The x-ray does afford most valuable assistance in the diagnosis of tuberculosis, for it not only tells us of the location and extent of the lesion, but to the experienced observer it also shows the character or type of the lesion much more accurately than can be told by physical signs or symptoms alone. It affords the most exact information as to the actual pathology that can today be gotten short of autopsy. But it must nevertheless not be looked upon as infallible; nor must it be taken as the final word in diagnosis. Its use should rather be for aid and corroboration in diagnosis and for better knowledge of extent and pathology. In pulmonary tuberculosis, as in all diseases, the use of the x-ray for diagnosis must be based upon a good knowledge of the pathology and course of the disease, an orientation in it, so to speak."

GOETZE, O. Radiological Diagnosis with a Distended Abdomen; a New Method. (*Münchener medizinische Wochenschrift*, November 12, 1918.)

O. Goetze, in an important article illustrated by thirty figures, sums up the technique and results given by a new radiodiagnostic procedure consisting in distending the peritoneal cavity with oxygen or simply atmospheric air. This causes a sort of dissociation of the abdominal viscera which then become accessible to radioscopy and radiography. For the introduction of oxygen, the writer employs a special apparatus or injects the gas through lumbar puncture needles. A practised hand will readily determine when the needle has entered the peritoneal cavity. The point of puncture should be selected at from three to five centimeters below the umbilicus in the middle of the left rectus muscle, or below the costal margin outside of the hepatic dullness. Insufflation of from two to three liters of oxygen is easily tolerated in all cases. As to contra-indications to the procedure, they are all serious disturbances of the circulation and respiration, acute or adhesive peritonitis (danger of perforating the intestine), etc. The gas is evacuated after radiography has been done. This procedure has not influenced the temperature or pulse in over ninety cases in which it was resorted to. The illustrations show the really remarkable results obtained, revealing as they do peritoneal adhesions, ascites at the beginning, neoplasms of the viscera or abdominal walls, various forms of hernia (among others the diaphragmatic, whose diagnosis is always a difficult, not to say impossible, matter), enlarged mesenteric lymph nodes, changes in the abdominal aorta, caries of the spine and pelvic bones, abscess, the shape of the lower cardiac limits, pericholecystitis, renal calculi, renal changes, splenomegalia, pathologic conditions of the bladder (simultaneous intravesical and abdominal insufflation), growths of the uterus and adnexa, pregnancy, etc.—all examples for the use of this procedure. The writer announces another paper for the near future, the present one being merely preliminary.

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THE UNSUSPECTED FOREIGN BODY AS A FREQUENT CAUSE OF CHRONIC BRONCHITIS

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To those whose memory covers a period of thirty years or more, the impression made upon our lay and early medical minds by the accident of a foreign body in the lung is quite too vivid to have been entirely modified by later-day developments.

The lasting impression is that the accident is of such frightful importance and its sequelæ so rapidly fatal as to be wholly incompatible with the words "unsuspected" and "chronic," and of such rare occurrence as to make the use of the word "frequent" quite unjustified.

The writer hopes in this communication to aid, in a small way at least, to correct these false impressions, and to present material fully adequate to justify the title chosen.

Acknowledgment must be made of the courtesy of Dr. Chevalier Jackson, from whose clinic all the material here presented has been taken, and whose permission and help have made this paper possible.

The inhalation of a foreign body is ordinarily accompanied by vivid sensations of suffocation and usually of terror. What then are the factors which make an unsuspected foreign body in the lung possible?

First and foremost must be placed infancy and childhood. The average mother sees several instances of inhaled foreign body lodging in the larynx or glottis. This familiar accident, with its short, sharp struggle and the instantaneous relief as the object is coughed out, is responsible for most of our impressions. What is less well recognized is the fact that relief is almost as rapid and complete if the body is released downward and passes into or beyond a main branch bronchus. It is most probable that in some of the cases here recorded the accident occurred in early childhood and was either not witnessed by the parent at all or quite discounted because of the immediate relief. It is significant, too, that if the accident has been witnessed, the child is reported to have swallowed, and not inhaled, the missing object.

In later life the habit of carrying small objects in the mouth and the quick inhalation of laughter or surprise is responsible for the accident, and the lack of sensation after the lodgment serves to allay the primary impression.

Intoxication is always to be reckoned with if such history is uncovered.

It is to be expected that many cases will develop from the vicissitudes of the present

war, since the habit of using the mouth as a handy receptacle will doubtless persist; and there also will be the occurrence of sudden painful injuries quite overwhelming the sensation of a concurrent choking.

Extreme physical fatigue such as is now occurring so frequently in the front line, followed by a sleep of exhaustion amounting to stupor, will again furnish all the other necessary factors, given a foreign body in the mouth.

The important things at the moment are, not how such an accident occurs, but that it does occur; that it is to be considered, and that it must be either eliminated as a cause or recognized as a cause in every case of chronic bronchitis or supposed tuberculosis of slowly advancing type.

Fortunately, we have to deal in chronic cases with objects inorganic in nature and therefore usually visible by roentgen rays. Inorganic, decomposable objects either are removed spontaneously or by the bronchoscope, or they rapidly produce abscess or other acute conditions. Exceptions to this rule will doubtless be found in small celluloid and aluminum articles and certain buttons, etc., made from organic, though not readily decomposable, materials. While invisible by roentgen rays, these will usually behave in the lung as do inorganic bodies and will produce a chronic reaction. The following case histories are cited as substantiating the claim indicated by the title.

Case I.—M. N., female. Philadelphia. Age, 23 years.

History.—The patient came to the clinic of Dr. J. Solis Cohen at Jefferson Hospital in 1911. She gave a history of continual cough and foul yellowish expectoration for about a year and a half, during which time she had had an irregular temperature elevation and had lost weight. For seven years she had been subject to severe cough with expectoration during the winter, these symptoms disappearing in summer. The diagnosis of pulmonary tuberculosis had been made by a number of physicians.

On physical examination both apices were found free from disease; the only abnormal physical signs were slight impairment of resonance at the right base, with diminished voice and breath sounds. As these did not in Dr. Cohen's opinion sufficiently account for the symptoms, he referred the case to Dr. Manges for roentgen-ray examination. Stereoscopic plates showed a stricture of the right bronchus, with a metallic body resembling an upholsterer's tack, point upward, below the stricture and behind the bronchus. The patient remembered having "swallowed" a price-tag fastener seven years before; but, as she was told that it would pass harmlessly, she had forgotten the occurrence. She had had no symptoms whatever until the following winter.

Case II.—H. E., male. California. Age, 20 years.

History.—Nine years ago, while eating beef and vegetable soup hurriedly, he felt a bone in his throat. He choked and coughed and expectorated what he thought was bone but his parents did not examine the sputum to see if bone was present. He spat up streaks of blood. Then constant cough supervened. He consulted many physicians, all of whom said the bone would have disappeared long ago. He was sent to a sanitarium, where he was given seven months' rest crue, and autogenous

Fig. 1.

vaccine. The sputum examination was negative. The cause of the abscess was not known. Dr. Zimmerman of Sacramento made stereoscopic plates showing what was thought to be a bone. Bronchoscopy was done in San Francisco seven years ago with negative result. (Fig. 1.)

Roentgen-ray examinations by Dr. Manges revealed a small foreign body shadow with considerable accompanying pathology in the region of the right descending branch bronchus. The foreign body was removed by oral bronchoscopy April 19, 1917, by Dr. Jackson. It proved to be a piece of bone.

CASE III.—J. W. B., male. Canada. Age, 58 years.

HISTORY.—For six months the patient had typical signs and symptoms of chronic bronchitis with acute exacerbation. There was no history of onset, merely a cough which persisted. Sibilant and sonorous râles in the left lung cleared up after a couple of months, but a small area in the right lung in the region of the lower portion of the upper lobe and upper portion of the middle lobe did not clear up, and nothing seemed to help it. Fluoroscope examination by the attending physician disclosed at the hilus of the right lung a dark area, which he attributed to calcified glands.

After several months, the condition not improving, the patient was referred to Dr. W. B. Bowman, of Los Angeles, who reported a foreign body in one of the large bronchial branches on the right side near the root of the right lung, with marked peribronchial thickening in the lower lobe of the right lung, some peribronchial thickening in the left side, and many fibrous changes, probably of non-tuberculous origin.

Roentgen ray examination by Dr. Manges (Fig. 2) led him to believe that there was a tubular metallic foreign body present. The foreign body was removed by oral bronchoscopy April 21, 1917, by Dr. Jackson. It proved to be the tip of an atomizer which the patient remembered using for a throat condition. The tip came off during use, and the exact nature of the foreign body was not suspected until after removal.

CASE IV.—M. T. McM., female. Tennessee. Age, 3 years.

PRESENT ILLNESS.—Nov. 5, 1916, the patient fell while holding a safety pin in her mouth. She became hoarse and developed a severe whoop-like cough. She was treated for laryngeal diphtheria. The severe cough with paroxysms was sometimes

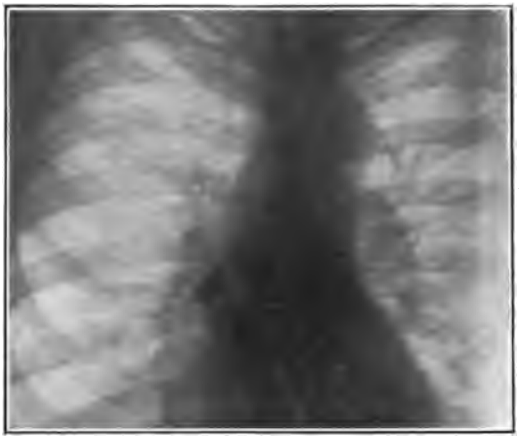

FIG. 2.

attended with vomiting and expectoration of purulent material, which continued to the present time. June 8, 1917, she coughed up the blade portion of a small safety pin. Fluoroscopy showed the remainder of the pin in the left bronchus.

ROENTGEN RAY REPORT.—June 19, 1918. (Fig. 3.)

There is a safety pin in the left bronchus; half of the pin carrying the shield is broken off just at the coil; the coil and pin are missing. As it lies in the bronchus this broken end is apparently in the bifurcation of the trachea, while the shield is down the left bronchus, the shield being rotated backward.

The foreign body was removed by oral bronchoscopy, June 19, 1917, by Dr. Jackson.

CASE V.—M. E. T., female. Washington, D. C. Age, 15 years.

PRESENT ILLNESS.—Sept. 2, 1916, while holding pins in the mouth in the act of undressing, the patient was frightened and aspirated some of the pins. She had a paroyxsm of coughing attended by some hemoptysis and substernal pain on breath-

FIG. 3.

ing and coughing. One week later she was taken to a hospital in Washington, D. C., where by the roentgen rays three small pins (straight, ordinary) were found in the intestines. She was studied four months and then discharged with the statement that the pins had been passed. During this time the patient had complained of substernal pain on deep breathing and coughing; coughing (worse on lying down and after eating) was attended by purulent and occasionally blood-streaked sputum. At times she spat up about one dram of bright red blood. She vomited after each meal and sometimes during sleep. She lost 18 pounds in weight and had occasional night sweats. These symptoms led to a chest examination. The roentgen ray examination showed a safety pin in the left lung. Attempts at removal were made under ether with failure to recover the pin, and the case was referred to Dr. Jackson.

The examination at Jefferson Hospital by Dr. F. F. Borzrel showed the pin lodged in the left bronchus. It was removed by oral bronchoscopy June 23, 1917, by Dr. Jackson.

CASE VI.—M. W., female. Pennsylvania. Age, 12 years.

PRESENT ILLNESS.—In May, 1917, the patient was holding a shoe button in her mouth as she ran upstairs. Her father came out of a nearby room and as the patient gasped from fright she aspirated the shoe button. A couple of days later she began to cough, and in June developed pneumonia. Since then, the cough has increased. During this illness the patient suffered from pain in the left arm, upon motion, which started under the left scapula and radiated down the arm to the elbow. The pain was present only upon motion and disappeared when she had recovered. She had an attack of la grippe in August, 1917, and the pain

FIG. 4.

in her left arm reappeared. Upon recovery from la grippe the pain disappeared. The patient has gained weight in the last few months.

My Roentgen Ray Report.—Dec. 17, 1917. (Fig. 4.)

I find a shadow in the left chest at the level of the upper border of the seventh rib, posteriorly, and at about the level of the upper border of the third rib, anteriorly. This shadow presumably represents the wire eye of the shoe-button which the child is supposed to have inhaled. It is impossible to visualize the button itself.

The foreign body was removed by oral bronchoscopy, December 18, 1917, by Dr. Jackson.

Case VII.—D. W., male. South Carolina. Age, eight years.

Present Illness.—In February, 1916, the child put a tack in his mouth and took a deep inspiration, aspirating the tack. Paroxysms of coughing immediately followed the accident, but these soon subsided. Three days later pneumonia developed and lasted ten days. The doctor who treated the patient for pneumonia was told of the "swallowing" of the tack, but ignored it. The cough continued and the patient lost weight and failed to develop physically following his illness. In March, 1917, the patient was sick four days and was treated by Dr. S., South Carolina. Dr. S. was told of the tack and in April, 1918, because of the child's continued coughing and failure of development, referred the patient to Dr. A. R. Fike of Spartansburg, who made a radiograph which showed a tack in the right bronchus. Two unsuccessful attempts were made at bronchoscopic removal during the month of April, 1918. Some slight reaction followed the bronchoscopic attempts.

My Roentgen Ray Report.—May 16, 1918. (Fig. 5.)

There is considerable pathology in the right lung, which to some extent, at least, involves the parenchyma of the lung. The larger bronchial branches can be seen penetrating the lung. The nail is now lying in a branch of the lower left bronchus, nearly midway from before backwards. There is considerable pathology also on this side, but very much less than on the right. The head of the nail is directed downward.

The tack was removed by peroral endoscopy, May 17, 1918, by Dr. Jackson.

Case VIII.—R. D. M., male. Canada. Age, eight years.

Present Illness.—When two and a half years old while seated at the dinner table the child suddenly spat up a mouthful of blood. An attack of broncho-pneumonia followed, lasting one week. A severe cough

Fig. 5.

productive of a purulent expectoration followed the broncho-pneumonia, and at irregular periods the child spat blood in amounts varying from a mouthful to blood-streaked sputum. For about two years these symptoms continued in great severity, finally decreasing in severity and the hemoptysis ceasing. The cough, however, persisted and the purulent expectoration continued at intervals. There has never been a septic temperature, nor have there been night sweats. The child failed to grow strong and was examined repeatedly for tuberculosis. The sputum reports have always been negative. A roentgen-ray examination of the chest was made in

June, 1917, when a foreign body was discovered in the lower right lobe. There were two bronchoscopies under ether anesthesia at an interval of one week. Both failed and the patient was sent home.

EXTRACT FROM MY REPORT.—June 3, 1918. (Fig. 6.)

There is a foreign body in the base of the right lung. By fluoroscopy the diaphragm shadow may be seen to rise so as to cover completely the foreign body shadow, and fall so as to clear it entirely.

FIG. 6.

The foreign body is slightly less than three-quarters of an inch in length and about one-quarter of an inch in diameter at its upper larger and blunt extremity. From this it tapers to a rounded point. I have a suspicion that it is the steel tip which fits into a tubular umbrella stem. There is strikingly little pathology to be seen—just a slight increase in density around the foreign body.

The foreign body was removed by oral bronchoscopy, under fluoroscopic control, June 4, 1918, by Dr. Jackson.

CASE IX.—M. J. C., female. Pennsylvania. Age, 48 years.

PRESENT ILLNESS.—In the middle of February, 1918, while trying to hang a curtain she aspirated accidentally a large double pointed carpet staple. Immediately following the accident the patient strangled and coughed for 5 or 10 minutes, and spat small amounts of blood. The symptoms subsided but the patient had the sensation of a foreign body in about the middle of the left chest. Later symptoms consisted in cough and copious yellowish purulent expectoration, never blood-streaked. At the time of the accident the doctor who was consulted insisted that the patient had swallowed the staple and advised eating dry foods. (He gave no cathartics.) The general health seemed but little affected, with the exception of early fatigue and interference of sleep by the incessant coughing. About one month ago she began complaining of a dull, aching pain in the left fifth interspace about two inches from the midline. This pain was aggravated by coughing, and lately has been referred to the left back. The amount of expectoration has grown less, and on two occasions the sputum contained black, crummy masses. The patient complains of an inky taste in the mouth after coughing. The doctor had urged a roentgen ray examination of the chest, but the patient delayed until the pain in the chest became annoying.

Roentgen ray examination at Geisinger Hospital, Danville, Pa., July 17, 1918, revealed the staple.

MY ROENTGEN RAY REPORT.—July 20, 1918. (Fig. 7.)

Carpet staple in the left main bronchus. Apparent width of spread between points is approximately correct. Length of the two arms is slightly foreshortened. Resulting pathology not apparent.

The foreign body was removed by oral bronchoscopy, July 22, 1918, by Dr. Jackson.

CASE X.—W. J. A., male. New Mexico. Age, 22 months.

PRESENT ILLNESS.—On May 17, 1918, while the patient was playing in the yard his mother heard him choking and strangling. She thought he had swallowed something and held him upside down and provoked vomiting by passing her finger down his throat. He coughed for about an hour. He complained of pain in the region of the larynx and the respiration increased in rate and became labored and wheezing; the nostrils became pinched and great cyanosis developed. Doctors were consulted and advised immediate hospital treatment. The patient was taken to a New Mexico hospital, where the doctor examined the patient and passed a forceps, the ends of which were wound with cotton, down the throat. This procedure seemed to relieve the pain in the throat, but the dyspnea continued. The doctor did not think a foreign body was present. A roentgen ray examination was proposed, but during the child's four days' stay in the hospital this was not done. The mother became impatient and took him to St. Louis where Dr. Belton made a roentgenograph and reported the presence of a tack in the right bronchus at the level of the sixth rib. On the arrival in St. Louis the dyspnea gradually subsided. A bronchoscopy was done under ether lasting one hour, but the tack was not removed. Considerable hoarseness followed the bronchoscopy, but no dyspnea developed. The patient was discharged from hospital two days after the bronchoscopy. He has lost some weight since the accident and now complains of an occasional cough, and restlessness, but has gradually improved since the bronchoscopy.

FIG. 7.

MY REPORT.—August 12, 1918. (Fig. 8.) There is a carpet tack, head downward, in the vicinity of the lower lobe bronchus. The head is too low down to be contained in a bronchus of normal diameter, but the location and direction correspond very accurately to the normal position. It is situated opposite the sixth rib, approximately two inches below the arch of the aorta.

The foreign body was removed by oral

FIG. 8.

bronchoscopy, August 12, 1918, by Dr. Jackson.

CASE XI.—V. M. S., female. Florida. Age, 38 years.

PRESENT ILLNESS.—Eight years ago the patient began to be troubled with a cough, and once a week would expectorate a mass of material the size of a pea, of a cheesy consistency, greenish-brown in color and of foul odor. She was thoroughly examined in Kansas City but no evidence of tuberculosis was found. The sputum and all secretions were examined. She led an out-of-door life for the next two years. It was then necessary to have a perineorrhaphy performed and she went to her home in Binghamton, N. Y., where Dr. —— in the course of his examination had a roentgen ray made of the chest, and found an open safety pin present in the right bronchial region. Dr. —— advised "leaving the pin alone as long as it left her alone." The cough increased in severity and frequency and masses similar to those first described were expectorated more frequently. In the latter part of May, 1918, she had a pulmonary hemorrhage followed by a second a week later. Hemorrhages recurred once and twice daily until the time of admission. The amount varied from six to sixteen ounces. Her physician considered the case tuberculous in spite of being told of the presence of the safety pin in the lung, and he wired the husband that the case was hopeless. Mr. S. immediately left for Florida and brought his wife to Philadelphia for treatment by Dr. Jackson. She arrived in a stuporous condition, coughing up blood-streaked sputum. Her breath smelled of acetone. The patient and her family had no knowledge of how or when the foreign body was aspirated.

ROENTGEN RAY REPORT.—July 11, 1918. (Fig. 9.)

There is an open safety pin in the right thorax which I believe is engaged in the inferior branch of the right bronchus. There is a great deal of pathology in both lungs, but particularly in the right lower lobe, where there is a thickening which amounts almost to consolidation, although the bronchial tree markings can be plainly seen through the density. The pathology on both sides diminishes markedly toward the apex.

The patient was admitted to the Hospital July 11, 1918.

She died July 15, 1918. No bronchoscopy was done.

Extended description of technique has no place in this paper, but caution may be urged as to two points:

In the determination of minute bodies, small pins for instance, motion must be eliminated completely or there may result a plate of rather pleasing quality but quite

FIG. 9.

worthless for the purpose, because the foreign body has not remained long enough at any one place to cast a visible shadow. This is particularly true if the body is lodged toward the lung base. The respiration must be lengthened or the exposure shortened to the point where perfect lung exposure for the entire exposure is assured. The patient, not the tube, is to have first consideration. In children too young to cooperate by holding the breath, I use a tube that will pass about 150 ma. at a five inch spark gap and make the exposure at the peak of respiration without an intensifying screen.

The second caution is to repeat what has been said often and well in previous meetings by Dr. Johnston. Objects in the lung which are quite invisible by roentgen rays may still frequently be localized by a visible surrounding pathological condition. Don't say you can't show them until you have tried.

CONCLUSIONS

For a variety of reasons unsuspected foreign bodies in the lung are of frequent occurrence, much more frequent than previous experience has indicated. The usual diagnosis is chronic bronchitis; less frequently, it is slowly advancing tuberculosis. The average general practitioner today is far too apt to discount the probability of the presence of a foreign body in the lung.

It is not only the privilege of the roentgenologist, but his manifest duty, to urge upon his medical conferees. in season and out, when opportunity offers and when opportunity has to be created, that all cases of obscure lung pathology should be examined by roentgen rays, if for no other reason than to determine the presence or absence of foreign bodies.

ROENTGEN RAY AND RADIUM IN THE TREATMENT OF BASAL CELL EPITHELIOMA*

A STATISTICAL STUDY

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THE first basal cell epithelioma to be treated with the roentgen ray was demonstrated before the Swedish Medical Society on Dec. 19, 1899, by Stenbeck[1] of Stockholm. At the same meeting Sjögren[2] showed a similar case. In the former instance, however, the epithelioma had disappeared, while in the latter the demonstration occurred before a complete cure had been effected. These reports were immediately followed by others and very soon the literature was swamped with articles on this subject. The earliest reports in Europe were from the pens of Sederholm,[3] Scholtz,[4] Taylor,[5] Ferguson[6] and Sequeira.[7] In the United States the earliest workers were Johnston and Merrill,[8] Pusey,[9] Williams,[10] Beck,[11] Rinehard,[12] Morton,[13] Hopkins,[14] Allen[15] and Duncan.[16]

In the past twelve years a voluminous literature dealing with roentgenotherapy in basal cell epithelioma has been developed. But before reviewing and commenting on the more important articles the author desires to tabulate and discuss the results obtained in 258 unselected cases of basal cell epithelioma which were treated between the years 1910 and 1916, inclusive. The cases were treated in accordance with the intensive technic and the doses were carefully measured.

SCOPE OF THE AUTHOR'S OBSERVATIONS

Of the 258 cases, 36 were not seen after the first treatment, so that the result could not be recorded. This leaves a total of 222 cases that remained under observation for at least a few months. Of these 222 cases there were 201 clinical cures, or 90 per cent. Fifteen patients, 6 per cent, improved, and in six cases, 2 per cent, the lesions were not even benefited. When it is considered that the cases were not selected and that at least one-half the failures were due to the patients' inability to have second or third treatments at

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proper intervals, or that the case was deemed practically hopeless when treatment was instituted, 90 per cent seems very satisfactory. As an illustration, several of the patients received a single treatment which did not suffice to effect a clinical cure. Then, on account of illness, old age, stormy weather, or other reasons, they did not return for the second treatment until the lesion was worse than it was at the beginning. In other instances the lesions were very deep and indurated, even involving the articulations or the entire orbit, and had received previous roentgen ray treatment. If one could omit such cases the percentage of cures would be in the neighborhood of 96 or 98 instead of 90.

Pre-epitheliomatous lesions are not included in this study. In other words, every case was distinctly an epithelioma from a clinical standpoint and they varied in size from a split pea to several inches in diameter, in duration from a few months to several years and either developed as a nodule or evolved from some pre-epitheliomatous lesion, usually a so-called seborrheic wart. In only a few cases was the diagnosis confirmed by the microscope, but in most instances the individuals were seen by dermatological confrères who agreed with the diagnosis. It would be senseless to biopsy every case of basal cell epithelioma because it is one of the easiest conditions for the dermatologist to recognize.

OCCURRENCE OF RELAPSES

Now regarding the question of relapses. Of the 201 clinically cured cases, 43 failed to remain under observation for six months. As will be seen later, most of the recurrences take place between six months and one year so that patients that are not observed for at least six months are of little statistical value so far as concerns the question of recurrence. We have, then, a total of 158 cured cases that were observed for periods of from six months to five or more years. In this series of 158 cases there were 24 relapses—15 per cent, leaving a total of possible permanent cures of 85 per cent.

A more critical analysis reveals that 16 cases were observed for five years or more with only one relapse—about 94 per cent of supposedly permanent cures. Forty-six cases remained under observation for four years. In this series there were nine relapses, leaving 80 per cent of probable permanent cures. Seventeen cases were followed for three years in which there were three recurrences—82 per cent cures. Of the two-year cases (about two years) there were 32, with five relapses—84 per cent cures. Thirty-four cases were observed for about one year with five recurrences—85 per cent cures. Thirteen cases were followed for six months—one relapse, 92 per cent cures. Finally, 43 cases were observed for from one to five months. In this series there were no relapses. Table 1 summarizes these statistics and enables the reader to grasp them at a glance.

TABLE 1.—CURES AND RELAPSES ARRANGED ACCORDING TO THE NUMBER OF YEARS UNDER OBSERVATION

Period of Observation	Number of Cases	Number of Relapses	Percentage of Cures
5 years	16	1	93.75
4 years	46	9	80.439
3 years	17	3	82.352
2 years	32	5	84.375
1 year	34	5	85.439
6 months	13	1	92.307
Less than 6 months	43	...	100

In this connection it is interesting to note that most of the recurrences manifested themselves in less than a year. As indicated in Table 2, there were 24 cases of relapse, 18 (75 per cent) of which occurred in the first year. Four were noted in the second year and two in the third year. These findings are valuable as they tend to indicate that if the patient can be kept under observation for a year, and there has been no recurrence during this time, the chances are that a permanent cure has been established.

POSSIBILITY OF LATE RELAPSE

Inasmuch, however, as one relapse was noted as late as the third year, it is advisable to warn the patient of this possibility.

That there is not much likelihood of a récidive after the third year, in properly treated cases, is shown by the fact that 79

TABLE 2.—RELAPSES ARRANGED BY TIME OF OCCURRENCE

Relapsed at End of	Relapse Treated with	Result	Second Relapse at End of	Second Relapse Treated with	Result
3 months	Excision	Cured			
5 months	Roentgen ray	Cured			
6 months	Roentgen ray	Cured			
6 months	Roentgen ray	Cured			
6 months	Roentgen ray	Cured	4 months	Roentgen ray	Cured
6 months	Roentgen ray	Cured	1 year	Roentgen ray	Cured
6 months	Roentgen ray	Cured			
6 months	Excision	Cured			
6 months	Roentgen ray	Cured			
6 months	Roentgen ray	Cured	6 months	Roentgen ray Radium	Failure
8 months	Radium	Cured			
8 months	Roentgen ray	Cured			
1 year	Roentgen ray, radium	Failure			
1 year	Radium	Cured			
1 year	Roentgen ray	Cured	1 year	Roentgen ray	Cured
1 year	Roentgen ray	Cured			
1 year	Roentgen ray	Cured			
1 year	Roentgen ray	Cured	1 year	Roentgen ray	Cured
1½ years	Roentgen ray	Cured			
1½ years	Roentgen ray	Cured			
2 years	Roentgen ray	Cured			
2 years	Roentgen ray	Cured			
2½ years	?	?			
3 years	Roentgen ray, radium	Failure			

patients were observed for periods of from three to five years, and yet there was only one relapse that manifested itself three years after treatment. A study of this chart will also show that 19 of the 24 relapses were treated again with the roentgen ray, and that 17 recovered. The two cases that did not respond to the roentgen ray also did not improve under the influence of radium. Two of the recurrences were cured with radium and two by surgical excision. It will be noted that five cases relapsed a second time within a year after the second recovery. Four of these lesions again disappeared under further roentgen ray treatment and one failed to respond either to the roentgen ray or radium. To recapitulate, 17 out of 19 primary relapses responded immediately to the roentgen ray—two failed to get well. Only one out of the five second recurrences failed to recover. From this it will be seen that a relapse should not cause unnecessary alarm.

EFFECT OF PREVIOUS TREATMENT

An attempt was made to ascertain if previous treatment altered the susceptibility of the lesion to intensive roentgenization. The result of this study is shown in Tables 2 and 3. There were 201 cured cases, of which the previous treatment was known in only 155. Three cases are omitted from the 21 failures because the previous treatment could not be ascertained, and four cases omitted from the 24 relapses for the same reason. The most noteworthy feature here is that 55 per cent of the failures were in cases that had been treated previously with the roentgen ray or radium, usually the roentgen ray in fractional doses over long periods of time. The percentages are obtained from the total number of cases as shown in the first column with the exception of the relapses. Here the "cured and not followed" cases were first deducted.

TABLE 3.—CURES, FAILURES AND RELAPSES ARRANGED ACCORDING TO PREVIOUS TREATMENT

Result	Number Cases	None	Excision	Caustics	Curettage, Cauterization	Roentgen Ray, Radium	Electricity
Cures....	155	83 54%	10 6%	22 14%	18 12%	16 10%	6 4%
Failures...	18	4 22%	1 6%	3 17%	0	10 55%	0
Relapses..	20	5 25%	2 10%	6 30%	0	5 25%	2 10%

Table 4 shows the results in relation to the number of treatments given. Only the cases with known end-results are recorded —222 cases.

TABLE 4.—RESULTS IN RELATION TO THE NUMBER OF TREATMENTS

Number Treatments	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures
First treatment cases.....	74	74 33%	14 19%	3 5%	
Second treatment cases....	93	91 41%	17 19%	12 16%	2 0.009%
Third treatment cases....	32	27 12%	2 7%	5 20%	5 2%
Fourth treatment cases..	12	7 3%	2 29%	2 40%	5 2%
Fifth treatment cases....	7	3 1%	....	2 66.66%	4 1.8%
Sixth treatment cases....	4	2 0.009%	1 50%	....	2 0.009%

It will be seen from Table 4 that 74 cases, 33 per cent of the total of 222, were cured as a result of one treatment. Or, considering only the cured cases (201), 37 per cent were cured in one treatment, 45

per cent in two treatments, 13 per cent in three treatments, etc. It is interesting to note that four obstinate cases received as many as six intensive treatments with two cures and no relapses. The percentage of cures is high as far as the third treatment. It would seem from this, as would be naturally assumed, that if a lesion is not favorably influenced by two or three intensive treatments, the chances of producing a favorable result with the roentgen ray is materially lessened. The percentages are obtained from the number of cases treated with the exception of the relapses. Here the "cured and not followed" cases are first deducted from the total number of cases treated.

RELATIVE VALUE OF MEDIUM AND HIGH PENETRATION

An attempt was made to determine the relative value of a medium and a high penetration. Unfortunately, the number of cases receiving a "medium" ray was small as compared with the number treated with a "hard" ray. Nevertheless, Table 5, which records these observations, is not without value. The study is based on a total of 200 "cured" cases. The other cases are omitted because the quality of ray used was either not recorded or it was somewhere between "medium" and "hard."

TABLE 5.—RESULTS IN RELATION TO THE QUALITY OF RAY

Quality of Ray	Number of Cases	Cures	Relapses	Failures	Cured, Not Followed
B 6–7	22	22 100%	2 9%		
B 9–10	178	157 88%	18 15%	21 12%	33 21%

It will be seen that as a general proposition, the medium quality gives the best results as shown by the 100 per cent of cures against 88 per cent with the higher penetration. The percentage of relapses is obtained by first deducting the "cured and not followed cases" from the total number of cases. The other percentages are obtained from the number of cases treated.

Table 6 records the cures in relation to the number of individual treatments administered in both the B 6 and the B 10 cases.

TABLE 6.—B 6 AND B 10 CASES ARRANGED ACCORDING TO THE NUMBER OF TREATMENTS

Quality of Ray	No. of Cases	No. of Cures	One	Two	Three	Four	Five	Six
B 6–7	22	22	9 41%	9 41%	3 14%	1 4%		
10	5	5	9	7	7	5	5	9
B 9–10	178	158	61 38.5%	69 44%	19 12%	5 3%	3 2%	1 0.006%

The percentages in Table 6 are obtained from the number of cures. For instance, there were 178 cases receiving the B 9-10 ray of which 158 were cured. Sixty-one of these 158 cures were given one treatment only, so that 38½ per cent of the cures were the result of a single treatment. It will be seen here, too, the "medium" ray apparently has a slight advantage.

Thirty-five of the cases with known end-results were treated with a B 9-10 ray filtered through 3 mm. of aluminum. A comparison of the results obtained with the filtered and unfiltered ray (B 9-10 being used in all these cases) will be found in Table 7.

TABLE 7.—RESULTS IN FILTERED AND UNFILTERED CASES

	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures
Filtered..........	35	21 60%	3 14.285%	6 35%	14 40%
Unfiltered........	147	141 96%	30 21%	13 11.666%	6 4%

The study outlined in Table 7 does not give the true comparative value of the two methods because, as a rule, the lesions that received filtered treatments were more deeply seated, larger and more indurated than were the lesions treated without the filter. The percentage of relapses are obtained after deducting the "cured and not followed" cases from the total number of cures. The other percentages are taken from the total number of cases.

NUMBER OF TREATMENTS REQUIRED

Some idea of the difference in malignancy or obstinacy of the lesions may be obtained by a glance at Table 8 which

shows the number of treatments necessary in individual cases both with the filtered and the unfiltered ray.

have been obtained after subtracting the cured cases that failed to remain under observation from the total of cured cases.

TABLE 8.—FILTERED AND UNFILTERED CASES ARRANGED ACCORDING TO THE NUMBER OF TREATMENTS

	Number of Treatments											
	One		Two		Three		Four		Five		Six	
	Filt.	Unfilt.	Filt.	Unfilt.	Filt.	Unfilt.	Filt.	Unfilt.	Filt.	Unfilt.	Filt.	Unfilt.
Number cases.	3	59	10	63	7	18	5	6	7	..	3	1
Cures.........	2 6%	58 40%	9 25%	62 42%	4 12%	16 11%	2 6%	4 3%	3 8%	.. ..	1 3%	1 0.006%
Relapses.....	.. ..	2 5%	2 28%	8 16%	2 50%	1 7%	.. ..	2 50%	2 66.66%			
Failures......	1 3%	1 0.006%	1 3%	1 0.006%	3 8%	2 1%	3 8%	2 1%	4 12%	.. ..	2 6%	
Cured, not followed......	.. ..	14 24%	2 22%	13 21%	.. ..	2 12.5%	.. ..	.. ..	. ..	.. ..	.. ..	1 100%

The key to Table 8 is as follows:

In the first vertical column there were three out of a total of 35 filtered cases that received only one treatment. Of these three cases, two were cured and one failed to improve. Therefore 6 per cent of the 35 filtered cases were cured in one treatment. The total 35 is obtained by adding the various filtered totals in the first horizontal column. In the second vertical column we find that 59 out of 147 unfiltered cases received one treatment. Fifty-eight of these patients were cured; in other words, 39 per cent of the total number of unfiltered cases were cured in one treatment. The failure percentage is also taken from the total 147, but for the relapses the "cured and not followed" cases (14) are deducted from the 58 cures and the percentage obtained from the remaining 44 cases that were cured and that remained under observation.

After eliminating the cases with unknown results there was a total of 43 lesions that were curetted immediately preceding the application of the roentgen ray. The curettage was very superficial, consisting of the removal of crusts, nodular masses and indurated borders. Table 9 gives a comparison between the results obtained in cases that were and those that were not curetted.

TABLE 9.—COMPARISON OF RESULTS IN CURETTED AND NONCURETTED CASES

	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures
Curetted...........	43	38 88%	5 13%	5 15%	5 12%
Not curetted........	179	163 91%	31 19%	19 15%	16 9%

The percentage of relapses, as in the other tables, to be of true statistical value, The other percentages are obtained from the totals in the first vertical column. It will be seen that there is not much difference in percentage between the cures that followed curettage and those that were not curetted. There is, however, considerable difference in the number of cases that were cured in one treatment, a matter of no little importance as will be shown later. Table 10 gives at a glance the number of treatments required in the curetted and noncuretted cases.

The percentages in Table 10 were obtained exactly as in Table 8. Here we see that 51 per cent of the total number of curetted cases was cured in one treatment as against 28 per cent of the cases that were not curetted.

EFFECT OF LOCATION ON RESULTS OF TREATMENT

On account of the frequent statements to the effect that epitheliomas in certain locations are particularly recalcitrant it was thought advisable to classify the results according to locations. Table 11 provides these statistics.

According to Table 11 the most stubborn lesions are those located at the inner canthus. Here we find 79 per cent cures, 26 per cent relapses and 20 per cent failures, as against 92 per cent cures, 7 per cent relapses and 8 per cent failures for lesions

TABLE 10.—CURETTED AND NONCURETTED CASES ARRANGED ACCORDING TO THE NUMBER OF TREATMENTS

Number of Treatments

	One		Two		Three		Four		Five		Six	
	Curetted	Not Curetted	Curetted	Not Curetted	Curetted	Not Curetted	Curetted	Not Curetted	Curetted	Not Curetted	Curetted	Not Curetted
Number cases	23	51	10	82	5	27	2	10	2	5	1	4
Cures......	22 51%	50 28%	10 23%	80 45%	4 9%	23 13%	1 2%	6 3%	1 2%	2 1%	.. ..	2 1%
Relapses....	1 5%	2 5%	2 22%	11 17%	1 33.33%	3 14%	.. ..	2 50%	1 100%	1 50%		
Failures....	1 2%	1 0.006%	.. ..	2 1%	1 2%	2 2%	1 2%	4 2%	1 2%	1 1.66%	1 2%	2 1%
Cured, not followed..	.. ..	11 22%	1 10%	16 20%	1 25%	1 4%	.. ..	2 33.33%	.. ..	.. ..	.. ..	1 50%

on the cheek. The following is the key to Table 11:

Refer to the nose cases (first transverse column). The total number of cases is 61. This includes the cures (59) and the failures (two). The unknown cases (patients not reporting after the cessation of treatment) are not included. The percentages of cures and failures are taken from the total 61. The percentage of relapses is obtained from the cures after deducting the "cured and not followed" cases.

CASES GROUPED ACCORDING TO CLINICAL TYPE

A compilation of statistics based on the clinical characteristics of the lesions offers material of prognostic value. In Table 12 an attempt has been made to divide the cases into groups possessing distinct clinical characteristics. The nodular lesions were those which consisted of a single nodule or a group of coalesced nodules. These lesions, while at times quite thick, were for the most part superficial. They ranged in size from a split pea to a dime and, occasionally, a quarter. They were not ulcerated and not crusted. The ulceronodular lesions were nodular lesions which had undergone more or less ulceration. Many of these lesions were as large as a 50-cent piece and some were the size of a silver dollar. The superficial ulcers were lesions ranging in size from a split pea to a silver dollar, free of nodules and induration. At times these consisted of hardly more than a superficial erosion covered with a crust. The deep, indurated ulcers in size ranged from a silver quarter to an adult hand. The induration was dense and the ulceration extended into the subcutaneous tissue, and in many instances involved the muscles and other important structures. The infiltrated plaques represent split-pea to quarter-sized areas of adherent hyperkeratosis with underlying infiltration. The verrucous lesion is the infiltrated plaque just mentioned with a papillomatous or verrucous surface.

TABLE 11.—RESULTS ARRANGED ACCORDING TO LOCATION

	Number Cases	Cured	Cured, Not Followed	Relapse	Failure
Nose..................	61	59 = 97%	10 = 17%	10 = 20%	2 = 3%
Internal canthus.......	24	19 = 79%	1 = 5%	5 = 28%	5 = 21%
Exterior canthus.......	8	7 = 87.5%	3 = 43%	....	1 = 12.5%
Forehead..............	35	32 = 91%	4 = 12.5%	6 = 21%	3 = 9%
Eyebrow...............	3	3 = 100%			
Cheek.................	37	34 = 92%	7 = 21%	2 = 7%	3 = 8%
Lip...................	8	7 = 87.5%	3 = 43%	....	1 = 12.5%
Chin..................	14	13 = 93%	4 = 31%	....	1 = 7%
Ear...................	5	5 = 100%	....	1 = 20%	
Behind ear............	7	7 = 100%	1 = 14%		
Eyelid................	6	6 = 100%	2 = 33.33%		
Neck..................	8	8 = 100%	....	1 = 12.5%	
Trunk.................	6	5 = 83%	1 = 20%	....	1 = 16.66%
Hand..................	4	4 = 100%			

The Key to Table 12 is as follows:

In the first horizontal column is shown the result obtained in the nodular type of epithelioma of which there were 67 cases which were kept under observation for at least a few months. The percentage of cures and failures are obtained from this total. The percentage of relapses is obtained from the cures after deducting the "cured and not followed" cases.

It will be seen that the highest percentage of cures and the smallest number of failures were obtained in the infiltrated plaques. This is also true of the relapses. Of the well developed epitheliomas Table 12 shows that the best results were obtained in the superficial ulcers. Next comes the nodular and then the ulcero-nodular cases.

TABLE 12.—RESULTS ARRANGED ACCORDING TO THE CLINICAL TYPE

	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures
Nodular	67	65 97%	13 20%	8 15%	2 3%
Superficial ulcer	16	16 100%	3 19%	4 31%	
Ulceronodular	84	78 93%	12 15%	7 11%	6 7%
Deep, indurated ulcer	43	30 70%	7 23%	6 26%	13 30%
Infiltrated plaque	12	12 100%	1 8%		
Verrucous	1	1 100%			

NUMBER OF TREATMENTS GIVEN VARIOUS CLINICAL TYPES

Table 13 shows the number of treatments administered to the various clinical types. Only the cured cases and the failures are recorded. It will be noted that 62.5 per cent of the superficial ulcers responded to one treatment as against 40 per cent for the nodular, 28 per cent for the ulcero-nodular, and 14 per cent for the deep, indurated ulcers. The infiltrated plaques show the best results with a percentage of 91.66.

TABLE 13.—LESSONS OF VARIOUS CLINICAL TYPES ARRANGED ACCORDING TO NUMBER OF TREATMENTS

Clinical Appearance	Number Cases	Number of Treatments					
		One	Two	Three	Four	Five	Six
Nodular	68	27 40%	29 43%	7 10%	3 5%	1 1%	1 1%
Superficial ulcer	16	10 62.5%	3 18.75%	3 18.75%			
Ulceronodular	85	24 28%	39 46%	13 15%	4 5%	4 5%	1 1%
Deep, indurated ulcer	43	6 14%	18 42%	11 25%	4 9%	2 5%	2 5%
Infiltrated plaque	12	11 91.66%	1 8.33%				
Verrucous	1	..	1 100%				

DEGREES OF REACTION OBSERVED

Table 14 shows the effect of varying degrees of roentgen ray reaction on the epitheliomas. Omitting the third degree reactions and the cases showing no reaction, on account of their small numbers, we find that the highest percentage of cures and the smallest percentage of failures and relapses occurred in connection with reactions of the second degree. The percentage of relapses is particularly misleading in this instance, because 53 per cent of the cured cases following a first degree reaction failed to remain under observation as compared with only 18 per cent in the second degree cases. The percentages in this table were obtained in the same manner as in Table 12.

TABLE 14.—RESULTS ARRANGED ACCORDING TO THE REACTION

Reaction	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures
No reaction	5	4 40%	1 25%	....	1 20%
First degree	59	43 73%	23 53%	18 90%	16 27%
Second degree	25	22 88%	4 18%	3 16.66%	3 12%
Third degree	2	2 100%			

EFFECT OF AGE ON RESULTS

Table 15 records the results in individuals of different ages. These statistics indicate the best results in young people, but the number of cases was too small to be of value. The next best showing was between the ages of 50 and 60, although when the table is carefully studied it is seen that age makes very little difference. The percentages were estimated in the same manner as those in Table 14.

EFFECT OF SEX ON RESULTS

The last table (Table 16) shows the results in relation to sex. The best results were obtained in females. The percentages here were obtained in the same manner as those of the preceding table.

STATISTICS FOUND IN THE LITERATURE

While there is a voluminous literature dealing with the roentgen-ray treatment

of cutaneous basal cell epitheliomas there are very few articles that give carefully compiled statistics. Pusey's[17] stastitics, published in 1907, do not differentiate between the basal cell and squamous cell types. In reading this article one gains the impression that most of the cases were of the basal cell variety. The report was based on 111 cases that were observed from three to six years. Four of the failures were clinically cured but relapsed.

TABLE 15.—RESULTS IN RELATION TO AGE

Age	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures
From 20 to 30	3	3 100%	1 33.33%		
From 31 to 40	25	21 84%	7 33.33%	2 14.285%	4 16%
From 41 to 50	64	58 91%	10 17%	6 12.5%	6 9%
From 51 to 60	56	53 95%	8 15%	9 20%	3 5%
From 61 to 70	32	28 87.5%	10 36%	3 16.66%	4 12.5%
From 71 to 85	23	20 87%	..	..	3 13%

TABLE 16.—RESULTS IN RELATION TO SEX

Sex	Number of Cases	Cures	Cured, Not Followed	Relapses	Failures	Unknown
Male	110	96 87%	19 20%	12 16%	14 13%	22 20%
Female	113	105 93%	17 16%	12 14%	8 7%	12 11%

Cured	80
Benefited	19
Failures	12
Total	111

Including under the heading of "cured" the four cases that relapsed, there were 84 cures in a total of 111 cases, 76 per cent. The percentage of relapse was 5. The roentgen ray was applied in fractional doses.

E. G. Williams[18] reported 53 cases of probable basal cell tumors, treated by the fractional technic. Of the 53 lesions, 52 healed under the influence of the roentgen ray. Nine patients were not seen again after they were clinically cured. Twelve cases were not observed for six months. The remainder, 32 cases, were followed for from six months to four years. There were six recurrences—three in the first year and three in the second year. They all healed a second time under the influence of the roentgen ray. In one case there were two recurrences and the lesion was clinically cured each time by a continuation of the same treatment.

Cures	52	Cures (observed more than six months)	31
Failures	1	Relapses	6
Total	53	Per cent relapses	19

In August, 1909, Sequeira[19] reported the results obtained by roentgenotherapy in 236 cases of basal cell epithelioma which were treated in the period between June, 1900, and Dec. 31, 1905. The fractional technic was employed.

Cured (under observation from three to six years)	75	
Cured (under observation for at least two years)	26	
Cured—relapsed—ultimately cured	31	
Cured—relapsed and failed to respond	7	
Total number of clinical cures	—	139
Improved—never quite healed	19	
Very little influenced	16	
Spread in spite of rays	7	
		181

The percentage of cures was 66. Of the 139 cures, 38 relapsed, making a percentage of recurrences of 27.

C. M. Williams,[20] in 1905 and 1906, reported 16 cases of basal cell epithelioma of which 11 were clinically cured—a percentage of 68.75. Two of the 11 cures relapsed (18 per cent), one at the end of seven months and the other in the second year. The patients were observed for a period of three years. The treatment was fractional. Most of the failures were in deep-seated, indurated rodent ulcers.

Stern[21] reports 85 cases of rodent ulcer treated with fractional roentgen-ray doses. In many of the cases the high frequency spark was employed to destroy the indurated edge. Forty-five of the 85 cases (53 per cent) were clinically cured. Nothing is known regarding relapses, as the patients were not kept under observation. Hahn[22] claims that he has cured 95 per cent and Schultz[23] 90 per cent of their cases of rodent ulcer, but they do not publish their sta-

tistics. Dachtler,[24] in 1917, published statistics based on the roentgen-ray treatment of 509 cases of cutaneous epithelioma. He does not separate the tumors into basal and squamous cell varieties, but it can be assumed that most of them were of the basal cell type, although many of them, as some of those of the lips (mucous surface), must have been of the squamous cell variety. Pre-epitheliomas were not included in the report.

The technic is not mentioned, but it probably consisted of fractional doses. The results are as follows:

Location	Males	Females	Total	Cured
Eyelids	98	47	145	134
Nose	61	49	110	102
Cheek	60	35	95	81
Lower lip	55	2	57	52
Forehead	17	27	44	43
Ear	22	3	25	20
Upper lip	12	6	18	16
Chin	6	2	8	8
Neck	7	..	7	7
	338	171	509	463

Dachtler does not include relapses in his statistics, but many of the patients were observed for from two to six years, and one gains the impression from a perusal of the article that there were few if any recurrences. The total percentage of cures was 91.

COMMENT

It will be seen that the lowest percentage of clinical cures in any of the statistics is 53 (Stern), while they run as high as 98 per cent (E. G. Williams). The lowest percentage of relapses was 5 (Pusey); the highest was 27 (Sequeira). It is of little practical value to compare these statistics, for some of them are incomplete, they treat the various items differently; some of them include both the squamous and basal cell types, while others do not, and the technic of the various authors differs materially. For the same reason it is impractical to endeavor to obtain a mean average of temporary and permanent cures. Most roentgenologists agree that it is possible to obtain as high as 98 per cent of clinical cures and from 94 to 96 per cent of permanent cures in selected cases of basal cell epithelioma and from 80 to 90 per cent of permanent cures in unselected cases.

In the author's statistics of unselected cases there was a percentage of clinical cures amounting to 90 with 15 per cent relapses. Most of the recurrences, however, responded to further treatment so that the original percentage of 90 is not materially reduced. It will be recalled that the cases that were observed for five years showed a percentage of permanent cures of 94; four-year cases, 80 per cent; three-year cases, 82 per cent; two-year cases, 85 per cent. These percentages can be increased by omitting the recurrences that again healed under the influence of the roentgen ray.

COMPARISON OF METHODS OF TREATMENT

Now let us see how these statistics compare with those associated with other methods of treatment. Hazen[25] reports a series of 178 basal cell epitheliomas which were treated by surgical excision. Twenty-eight patients were his own, the remainder being borrowed from the service of Dr. Bloodgood at the Johns Hopkins Hospital.

Sixty-four patients were kept under observation for more than three years. Four of these patients were well at the end of three years; 13 at the end of four years; 39 after five or more years. In seven instances there was a recurrence. This gives a percentage of permanent cures of 86 in the unselected cases. There were five practically hopeless cases, and if these are omitted and only the selected cases considered, the percentage of cures will amount to 93. A further study of the treated cases, as regards the duration and the extent of the lesion, gives the following data:

Duration	Cured	Recurrent
1 year	17	2
2 years	8	..
3 years	9	..
5 years	12	3
10 years	17	3
Size	**Cured**	**Recurrent**
Under 1 inch	33	2
From 1 to 2 inches	19	2
Extensive	4	4

It will be seen that there is really very little difference, according to statistics, between the results obtained by surgical excision and by the roentgen ray. Sherwell[26] obtained 90 per cent of permanent cures in unselected cases with the vigorous use of acid nitrate of mercury after a thorough curettage, but this estimation is not based on carefully compiled statistics. The literature does not appear to contain statistics based on the use of the various caustics such as arsenic, zinc, carbon dioxid snow, actual cautery, desiccation, etc. It has been claimed by A. Robinson and others that arsenical paste, if properly employed, gives as high a percentage of permanent cures as does any other method. And it is the consensus of opinion among dermatologists that a vigorous-acting caustic if thoroughly applied constitutes an excellent method of treatment. On the other hand, there seems to be very little confidence in carbon dioxid snow, superficial caustics, electricity and similar agents.

THE METHODS OF CHOICE

So far as concerns statistics the best results are associated with excision and with the roentgen ray, and as has been shown, the figures are very much the same in both instances if the work is properly done. Let us assume, therefore, that as far as concerns the prognosis, there is no choice between the two methods. Neither method can be carelessly undertaken. If the roentgen ray is to be applied it should be administered by one who possesses the ability and the means of employing a modern technic. In surgery there is only one difficulty, and that pertains to the complete removal of all diseased tissue. It is obvious that if all the malignant cells are removed there can be no relapse. The tendency, however, in order to obtain a good cosmetic result, is to cut too close to the macroscopic lesion. In a number of instances the author has obtained the excised tissue *in toto*, cut it serially and found that the proliferated epithelial cells extended right to the edge of the incision. It is a question if such an examination should not always be made and then if the indications warrant it, the roentgen ray can be employed to prevent recurrence.

OCCURRENCE OF SCAR FORMATION AFTER TREATMENT

In small epitheliomas, lesions that can be excised and the wound made to heal by primary intention and particularly if the subcuticular stitch is employed, the resulting linear scar is hardly discernible. In instances when there is considerable ulceration, the deformity subsequent to excision and primary union may be less than after the use of the roentgen ray, as the destruction of tissue by the ulcerative process may necessarily leave a scar. On the other hand, when there is not ulceration, or the ulceration is very superficial, it may be impossible to locate the site previously occupied by the lesion after a cure has been effected by roentgenization. In considering the cosmetic possibilities it is well to bear in mind that the amount of ray necessary to effect a complete cure may in some individuals produce subsequent wrinkling or telangiectasia or both. Furthermore, one must admit the slight possibility of overtreatment with the production of a serious chronic radiodermatitis.

RESULTS IN THE AUTHOR'S CASES

In the author's series of 258 patients there were only two cases of noticeable wrinkling and six cases of telangiectasia. This is in marked contrast to the number of instances of telangiectasia following the roentgen-ray treatment of other affections such as keloid, in which the ray was allowed to come in contact with the normal skin beyond the edge of the lesion. Perhaps this can be explained by the fact that in keloid, as a rule, one is dealing with younger subjects, or it might be a pure coincidence. Telangiectasia following a single erythema dose or subsequent to an erythema provoked by fractional doses is not a rare phenomenon, and it is curious

why it does not occur oftener in epithelioma in which considerable normal skin is exposed to one or more erythema doses. There were two cases of third degree radiodermatitis of small extent, both of which healed in a few months.

DISADVANTAGES OF SURGICAL INTERFERENCE

The surgeon, working with the knife, is at a disadvantage in extensive lesions in which it is difficult, if not impossible, to remove all the diseased tissue and in which the resulting wound must be allowed to heal by granulation, or in which skin grafting or a skin flap is necessary. Nevertheless, remarkable results can be obtained in such cases by a clever surgeon.

COMPARING OF RESULTS

It is unfortunate that no statistical comparison can be made with the results obtained by the use of curettage and strong chemical or electrical caustics. These methods do not yield as good cosmetic results as does the roentgen ray in small lesions, but in large, ulcerative lesions there is very little choice from the standpoint of cosmetics.

PRIMAL OBJECT IN ALL TREATMENT

In the treatment of epithelioma the main requisite is the complete destruction of the lesion—not a single malignant cell must remain. The cosmetic result while worthy of consideration is of secondary importance. Let us assume that the average basal cell growth can be cured by excision, roentgen ray or radium, or by very powerful caustics. This being true the author favors the roentgen ray or radium because there is no pain nor inconvenience to the healthy, active individual and no physical shock to the aged or weak patient. However, after one has had long experience in the use of these various methods of combating the disease he is likely to select the treatment or combination of treatments apparently most suitable to the individual case. In superficial lesions the author favors the roentgen ray and radium because of the good cosmetic results, the high percentage of permanent cures, and because there is no pain or inconvenience or loss of time to the patient. Lesions situated at the inner canthus, on the eyelids or on the nasal alæ are especially suitable for roentgenotherapy or radium therapy on account of the difficulty of applying adequate surgical methods to these locations. Extensive, deep-seated growths, especially when markedly indurated, are likely to prove very recalcitrant and such lesions can very often be most successfully combated by the use of the knife, the curet, chemical caustics, fulguration (desiccation) or the actual cautery, followed by one or two intensive applications of radium or the roentgen ray. Not only will this procedure add to the certainty of a prompt, permanent cure, but it will remove the necessity of a relatively large number of very intensive doses which would occupy considerable time and which might lead to undesirable sequelæ.

PROGNOSIS DEPENDS ON EFFECT OF PREVIOUS TREATMENT

It is well known that the previous treatment affects, to some extent, the prognosis. Table 3 shows that the most stubborn lesions are those that have received repeated courses of fractional roentgen-ray treatment. For this reason it would seem advisable, in selecting a method or a combination method to carefully consider the previous treatment and its result. If, for instance the skin in the neighborhood of the lesion shows roentgen-ray sequelæ (atrophy, telangiectasia, or similar conditions) it would seem advisable to employ some procedure other than the roentgen ray or radium. Finally, if a lesion does not respond at once to intensive radiation it is advisable to utilize some other method instead of proceeding with roentgenization indefinitely. Some roentgenologists will not agree with this statement. They are con-

vinced that every basal cell epithelioma can be cured with the roentgen ray or with radium if the dose is sufficiently intensive, the treatment being pushed to the point of producing a third degree radiodermatitis if necessary. In confutation of this opinion the author has studied tissue removed from roentgen ray ulcers (on the site of a basal cell epithelioma) of long duration and found actively proliferating epithelial cells deep in the tissue or at the edge of the ulcer.

TECHNIC OF APPLYING THE ROENTGEN RAYS

Now comes the question of choice of technic—intensive or fractional. Those who have watched the evolution of roentgenotherapy of epithelioma will admit that the tendency has been to intensify the technic. Years ago all operators employed the fractional method and it was indeed, with a few exceptions, very fractional. That is, in those days, it required from 25 to 50 or even more treatments to cause a small rodent ulcer to heal. The men who now employ the fractional technic accomplish the desired result in from six to twelve applications. Comparatively speaking, this is intensive treatment. The author has a very vivid and rather sad recollection of his early experience with the use of the fraction method in the treatment of basal cell epithelioma. Unfortunately, he kept no careful records at the time, and those that he did preserve were lost. The results were very poor and they remained poor until a more intensive technic was developed. As a matter of fact, the end-result of the roentgen-ray treatment of epithelioma was so bad at that time that it was difficult to obtain permission in New York to treat a case with the roentgen ray. In this connection, American roentgenology owes a debt of gratitude to Dr. William A. Pusey. While always an advocate of the fractional technic, comparatively speaking his treatment was intensive. And it was largely due to the persevering efforts of this well known dermatologist in making the profession acquainted with the possibilities of the roentgen ray in the treatment of epithelioma, that confidence in the work was finally restored.

While his percentage of permanent cures was only 76, it must be remembered that he included prickle cell cancer, that the cases were unselected, and that his results were given in 1907, at a time when roentgenologists were laboring under great disadvantages.

IMPORTANCE OF INTENSIVE TREATMENT

The literature does not seem to contain statistics based on a truly intensive treatment of basal cell epithelioma. The author admits that Dr. Pusey and many other men can equal, with the fractional technic, his statistics, but he does insist that for a good showing in a large number of cases it is essential that a reasonably intensive treatment be employed. And this is the opinion of the majority of roentgenologists.

The author's experience with the fractional technic of former years, with the fractional technic of to-day and with the intensive technic has led to a firm conviction that the last mentioned method offers the greatest advantages in the roentgen-ray treatment of epithelioma. It is fairly well agreed now that small doses of roentgen ray may actually stimulate a neoplasm and produce a more rapid growth. Furthermore, these small doses applied over a long period of time, may in some way cause the cell to resist the beneficial influence of the ray. These facts may explain, theoretically at least, why so many tumors improve for awhile under small doses and then grow steadily worse in spite of a continuation of the treatment. And it may also explain why such cases fail to yield to intensive roentgenization.

In this connection the author has noted that if a lesion has failed to respond to the old-fashioned fractional method and then several months or a year or two elapse without treatment, the lesion is more likely to respond to intensive roentgenization than when this treatment is administered immediately on the cessation of the fractional treatments. While the author has no figures

to prove it, his results have been very much better with the intensive than with the fractional technic and the increase in the percentage of permanent cures has apparently been directly proportionate with the increase in the intensity of the treatment, at least up to a certain point. Even with the fractional technic of to-day there is a theoretical stimulation with the first few applications, but the accumulative effect is probably sufficiently rapid to prevent injurious stimulation.

Speaking from personal experience the author has found that relapses following intensive treatment respond more readily to further intensive treatment than did the recurrences following his former fractional technic. In Table 2 is recorded nineteen relapses, seventeen of which were again clinically cured by one or two intensive treatments. Five of these cases again recurred, four of which again responded to further intensive treatment and have remained well for at least two years. Such results were not obtained years ago by the author although both Drs. Pusey and Williams succeeded in curing the same proportion of récidives with a fractional technic.

MAXIMUM SKIN TOLERATION APPLICATIONS ADVISABLE

There is another point that possibly favors intensive technic and that should receive some consideration. By administering a skin toleration dose it is possible to secure many small epitheliomas in one treatment. In the author's statistics 37 per cent were cured as a result of one application. For the sake of argument let us assume that this intensive dose for epitheliomas is H 2 B 10. Now, if this amount of ray is divided into fractions of H ¼ B 10 and administered twice weekly, it is likely to require H 3, H 4 or even more to bring about the same result. In other words, with the fractional technic the total dosage is greater than with the intensive method and as a rule the smaller the individual doses the greater will be the total dose. It is doubtful if this fact is of much practical importance, if the lesion is cured in a relatively few treatments as, for instance, when H ¼ or H ½, B 10 is given twice weekly. But when the fractions consist of H ⅛, 1/16 or less, the total dose is likely to be as high as H 15 or 20. Even here, the poor results may not be caused by the high total dosage, but rather to the fact that for the first few weeks or months of such treatment the malignant tissue is stimulated and made more resistant.

PRELIMINARY CURETTAGE

Until proof to the contrary is elicited it would seem, from a scientific point of view, preferable to cure a case with a minimum rather than with a maximum amount of ray. And it is for this reason that the author favors the use of some preliminary measure such as the curet in indurated or markedly nodular lesions. Table 10 strengthens this statement for we see that in the cases that were not curetted the percentage of cure as a result of one treatment was 28 as against 51 per cent in the curetted cases. There is no objection, other than cosmetic, to the use of the curet under local anesthesia in this type of epithelioma because there is no danger of metastasis.

The saving of time for the patient is at times of the utmost importance and certainly, if a lesion can be cured in one or two instead of many treatments, the individual is spared a great deal of trouble and time.

CAUSES OF FAILURES

While the intensive treatment, as a rule, fails only in lesions that are considered rather hopeless from the start, nevertheless, small, superficial lesions are at times remarkably rebellious and occasionally refuse to heal. These lesions, clinically and histologically, are identical with the growths that yield readily to the roentgen ray and it is impossible to formulate a satisfactory explanation for such failures. Many of the cases of this particular type in the author's practice were situated on the nose and for

awhile it was thought that location might influence the outcome but the statistics, as shown in Table 11, do not support this contention. These statistics show that the most rebellious lesions were situated at the inner canthus, while both Sequeira and Dachtler had the greatest trouble with lesions on the cheek.

QUALITY OF THE ROENTGEN RAY

In the selection of the kind of ray, quality is possibly a matter of more importance than roentgenologists have been willing to admit. The author is not aware of any carefully conducted experiments to determine the best quality of ray for the different clinical types of basal cell epithelioma. He has employed a B 10 ray as a routine because it was thought that the higher penetrations allowed a greater margin of safety and because the results seemed satisfactory. It will be recalled that Table 5 showed 100 per cent clinical cures and 9 per cent relapses with a B 6 ray as against 88 per cent clinical cures and 15 per cent of relapses with a B 10 ray. Acknowledging the fact that statistics are more or less unreliable, but accepting them at their face value, the "medium ray" in this instance has a decided advantage.

Schultz[27] has succeeded in curing epitheliomas with very "soft rays" that failed to respond at all to a ray of greater penetration. He avers that the quality of ray employed should be in accordance with the specific gravity of the tumor mass. Regardless of the reason for this phenomenon, it is a fact that a superficial epithelioma that has failed to improve under the influence of roentgen rays of medium or hard penetration, may heal as a result of an intensive application of the beta rays of radium. It is possible, therefore, that "medium," "soft" and very "soft" roentgen rays are indicated in certain cases. That they are not indicated in all cases is demonstrated by the fact that an occasional tumor will respond better to a well-filtered hard ray than to rays of lower penetration. It is possible that both the depth and density of the lesion are deciding factors. In deep and indurated lesions the dose that reaches the lowermost part of the growth when a "low ray" is used, may be relatively small and just about enough to stimulate rather than retard the growth. It is quite possible, therefore, that the quality should be selected that is best suited to the individual case. Before this can be done with reasonable certainty considerable experimental work will be required. Basing an opinion on what is already known, it would seem that a "soft" ray would be most suitable for the superficial, nonindurated growths and the filtered "hard" ray for deep-seated, dense, indurated lesions.

GOOD COSMETIC EFFECT DESIRED

While the cosmetic result in the treatment of epithelioma is of secondary importance, yet, when it does not interfere with the cure of the disease, one is justified in attempting a pleasing result from a cosmetic point of view. It will not do, of course, to limit the exposure to the macroscopic lesion. The surrounding skin, also, must be treated, and if an erythema is provoked telangiectasia may follow. Telangiectasia may be avoided by administering suberythema doses at suitable intervals, or, if one is dealing with an ulcer, a full erythema dose can be applied to the lesion and a suberythema dose to the surrounding apparently normal skin. The author's practice is to administer H 2 B 10 (skin distance) to the lesion and to the normal skin for from ¼ to ½ inch beyond the clinical manifestation of the growth and H 1¼, B 10 (skin distance) to the normal skin for an additional ½ or 1 inch. H 2, B 10 (skin distance) will almost always produce at least a pronounced erythema and sometimes a dermatitis and even vesiculation, depending on the location, age, complexion, sex and similar factors.

In aged individuals or if the lesion is deep or markedly indurated, the dose is often increased to H 2¼, B 10 (skin distance), or even H 2½ (skin distance).

The smaller dose of H $1\frac{1}{4}$ to the normal skin will not, as a rule, produce more than a faint and transitory erythema. If it is necessary to make the application to the mucosa the dose is reduced to about H $1\frac{1}{2}$ because the mucous membranes are more susceptible than is the skin. When a ray of a quality of B 10 is filtered through 3 mm. of aluminum the dose may be increased. Here the minimum dose would be H 2 and the maximum H 3. If the quality is lowered it is advisable to also reduce the quantity. The intensive treatments are administered at intervals of from four to six weeks unless erythema persists, when a longer rest is allowed.

If there is not a marked response to the first treatment it is advisable to alter the quality for the second application, either using less penetration or greater penetration according to the character of the lesion and to urge or even insist on the use of the curet and, finally, if the result is not satisfactory after the second intensive dose, the question of excision or some other reliable surgical procedure should be seriously considered.

For the fractional technic H $\frac{1}{4}$ B 10 (skin distance) unfiltered, twice weekly, or H $\frac{1}{2}$ once weekly, will provoke a faint erythema, as a rule in about a month, and a well pronounced erythematous reaction in from six to eight weeks. H $\frac{1}{3}$ twice weekly should effect a well marked reaction in about a month. If a filter is used the dose can be increased a little.

It is important that the normal skin, the hairy parts, the eye and other important organs be suitably protected with lead foil.

TREATING LARGE LESIONS

When dealing with large lesions—the size of a palm or an adult hand—the margin will receive a smaller dose than will the center of the growth on account of the increased distance and the fact that it is only the oblique ray that reaches the edge of the diseased area. To insure a fairly equal distribution of the dose in such instances it is advisable to divide the affected area into from two to four squares and administer a full dose to each square, care being taken not to allow overlapping. When the growth is situated on the upper eyelid the eye is cocainized and a piece of gauze saturated with bismuth paste is placed between the lid and the eyeball. Unless involved in the growth, the edge of the lid is also covered with the paste in order to protect the eyelashes.

Being cognizant of the experimental work conducted by Murphy at the Rockefeller Institute the author treated a few cases of basal cell epithelioma by exposing the general surface of the body to the roentgen ray. He was unable materially to increase the percentage of lymphocytes and there was no appreciable improvement in the lesions. Very little is known about the practical application of this method and perhaps further observation and experimentation will lead to better results.

EFFECT ON THE SURROUNDING TISSUE

In a few cases of basal cell epithelioma an erythema dose, while having the desired effect on the growth, appeared to produce a temporary overactivity of the sebaceous glands and of the epidermis which was manifested by the formation of thick waxy scales. It was noted that this phenomenon occurred only on the face. In one instance wart-like growths developed but disappeared in a week or two. It is possible that these phenomena represent either an overzealous or an abnormal attempt at repair. Occasionally, after the disappearance of the epithelioma, the former site of the lesion will be scaly for a number of months. In such instances a soothing ointment may be applied, but stimulating and irritating applications are contraindicated, as such measures are likely to provoke a dermatitis weeks and even months after cessation of roentgenization.

RADIUM

Unfortunately, the author has been unable to locate statistics showing the results of applying radium in the treatment

of basal cell epithelioma. Those who have employed both agents agree that the results are similar. Some claim that radium is superior and others that the roentgen ray is preferable. In the absence of statistics the author will be guided by his own experience.

AUTHOR'S OBSERVATIONS

In the first place radium will occasionally succeed after the roentgen ray has failed. In such instances the result has been achieved by the use of the beta-rays. In no instance has the author been able to effect a cure with the roentgen ray when radium failed. Furthermore, in cases in which the roentgen ray proved inefficacious the gamma-rays of radium also failed to be effective. The number of cases treated is too small and the length of time too short to make the statistics of any value. The impression gained is that for small, superficial lesions the more penetrating of the beta-rays are superior to the gamma-rays of radium, and the reverse is true for deep-seated, indurated growths. It is also the opinion that radium is somewhat superior to the roentgen ray for these small, superficial epitheliomas, providing the beta-rays are utilized and that all crusts, scales and discharge are removed before the application is made. The author has not detected any difference in efficacy between gamma-rays of radium and the roentgen ray. The radium applications have been intensive, one exposure being sufficient to produce a first or second degree reaction.

TECHNIC OF APPLYING THE RADIUM PLAQUE

It is, of course, a very simple matter to treat a small lesion with a radium plaque. If the growth is larger than the applicator, the entire lesion is covered by dividing it into areas and the plaque applied to each area, care being taken to avoid overlapping. If the applicator is considerably larger than the lesion, the latter is surrounded with lead foil as when applying the roentgen ray. The dose will depend on the amount of radium element contained in the applicator. While the author prefers intensive treatments, the erythema dose may be divided into fraction. If, for instance, it requires 15 minutes with the unfiltered applicator in contact with the skin to produce a marked erythema, five fractional doses of three minutes each could be given, although it will probably require a total of from 20 to 25 minutes fractionally administered to obtain the same degree of reaction as affected by the single application of 15 minutes. The difference in time of exposure between filtered and unfiltered radium, especially if a lead filter is employed, is enormous, and unless one has a very large amount of the element the time required (several hours) for an intensive dose is a positive nuisance, especially when one considers that the results of such treatment are no better than those obtained with the roentgen ray, which only requires a few minutes for the administration of an intensive dose.

CASES IN WHICH RADIUM TREATMENT IS PREFERRED

There are instances in which radium is of especial service. In cases in which the lesion is situated on the eyelid, the beta-rays may be employed and the eye itself need not be protected excepting by the lead foil which surrounds the lesion. The eye will not be injured by the small dose of gamma-rays and the more penetrating beta-rays that pass through the lesion and reach the eye unless several applications are necessary in which case it is preferable to protect the eyes as when using the roentgen ray. If the lesion is situated on the nose a radium plaque can be applied to the lesion and a tube of the element placed in the nose for the purpose of cross-firing.

When the lesion involves the nasal alæ and extends into the nose, or when situated at the commissures of the mouth and involving the buccal mucosa, or when located at the margin of the lids with involvement of the conjunctiva, radium is often easier to apply and may prove more efficacious

than the roentgen ray. Conversely, radium is more difficult to apply to the inner canthus than is the roentgen ray on account of the irregularly concave surface. When treating moist surfaces the unfiltered plaque is usually protected by a single layer of gutta-percha tissue, very thin rubber, or oiled silk.

In order to avoid the very superficial beta-rays a very thin filter ($^1/_{10}$ mm. aluminum) is advisable, even for superficial lesions. It should be borne in mind that radium, if improperly applied, will effect all of the sequelæ produced by the roentgen ray, namely, second and third degree "burns," atrophy, telangiectasia, peratoses, and similar conditions.

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ROENTGEN RAY INDICATIONS FOR TOOTH EXTRACTION

THE MEDICAL ROENTGENOLOGIST AS THE IMPARTIAL CONSULTANT FOR THE PHYSICIAN, THE DENTIST AND THE PATIENT

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THE roentgenogram shows when the condition about the infected tooth is such that it menaces the health of the patient. The trained roentgenologist can diagnose the condition which indicates extraction. This he should prescribe, as at present no other method can be guaranteed to remove the focus of infection.

ORAL FOCI OF INFECTION THE CAUSE OF SYSTEMIC DISEASE

"The idea that mouth infections often cause serious secondary effects has in recent years become definitely crystallized in the minds of physicians, dentists. and laymen." It is with this fundamental principle that Arthur D. Black[1] begins his discussion of "Roentgenographic and Microscopic Studies of Tissues Involved in Chronic Mouth Infection." And it is well to remember that it is this proven condition that necessitates the co-operation of the physician and dentist. Dr. Black continues: "Clinical observation has been supported by careful laboratory investigations. It is now generally recognized that a chronic suppurating focus may lead to any one of a considerable group of diseases, most of which are insidious in their development and extremely chronic in their progress. . . . It would seem desirable to establish the element of danger to health which these infections represent. . . . It is certainly illogical to conclude that a particular systemic effect is due to a mouth focus unless all other sources have been eliminated. Without question, in many cases, several sources are acting simultaneously."

The point is that no matter how many other sources of infection there may be, the fact still remains that if foci of infection exist in the mouth they should be removed to clarify the situation.

DISAGREEMENT AMONG DENTISTS AS TO PRACTICE

Until the advent of the roentgenographic diagnosis, which came like a day of judgment upon the incompetent and incapable, the principle of dentistry was the preservation of the tooth at no matter what cost. When modern medicine reached the conclusion that septic conditions exerted a greater influence on the health than had been previously thought possible, and supported this conclusion with pathological and roentgenographic examinations, dental practice had to be revised. Dental practice is still being revised, for the facts were too strong to be controverted.

For example: In 1911, Sir William Hunter[2] stated the case thus:

"The worst cases of anemia, gastritis, colitis, of all kinds and degrees, of obscure fever of unknown origin, of purpura, of nervous disturbances of all kinds ranging from mental depression up to actual lesions of the cord, of chronic rheumatic affections, of kidney disease, are those which owe their origin to, or are gravely complicated by the oral sepsis produced in private patients by these gold traps of sepsis."

In July, 1918, *Dental Cosmos* reprinted this article with editorial comment, which shows what an effect the weighing of the facts had had in the seven years elapsing between the original speech and their comment. They deprecate "the enthusiasm" which led to "advocating, even urging the *indiscriminate* extraction of teeth" and "the acceptation of oral sepsis and faulty

[1] BLACK, ARTHUR D., *J. Am. M. Assn.*, August, 1917.

[2] HUNTER, SIR WILLIAM, *Dental Cosmos*, July, 1918.

* Presented at the Nineteenth Annual Meeting of the American Roentgen Ray Society, Chattanooga, Tenn., September, 1918.

dentistry as the possible cause of many puzzling conditions met with by the medical practitioner." But, after this excursion, *Dental Cosmos* concludes fairly and justly: "While some of the statements made by Dr. Hunter are *perhaps rather excessive*, they are on the whole, we believe, in accordance with the general facts of the situation. Though the truth is frequently unpleasant, it is never unwholesome, and if the stimulus of Dr. Hunter's pointed criticism shall arouse the organized dental profession to renewed activity in the effort to eradicate the ignorant and incompetent practice of dentistry, he will have conferred a boon upon humanity."

PRESENT METHODS NOT ASEPTIC

When the roentgen ray was first introduced, it showed abscesses at the roots of teeth which had been pronounced aseptically filled and which were, clinically considered, sound.

F. B. Moorehead says: "The overwhelming majority of chronic abscesses being associated with previously treated root canals serves to emphasize the importance of root-canal technique. Faulty root-canal technique, the careless use of arsenic as a devitalizing agent, and irritating drugs in the treatment of root canals are strong predisposing factors of chronic alveolar abscess." Arthur Black and Clarence J. Grieves also report the septic condition of root-filled teeth.

The search began for methods which would render the tooth to be treated completely aseptic. As yet *no method* has been devised which will be efficacious in every instance. Concerning electrolytic medication Samuel E. Pond and Weston A. Price report: "It has been assumed by those using 'Electrolytic Medication' (a) that electrolytes or ions, (b) that electric current and (c) that the electrically precipitated elements, killed bacteria. We have (using the electrolytes recommended by practitioners) found no evidence to support such a position. It seems there is no such *direct* action leading to disinfection under present practice. If there is a beneficial action or disinfection, it must be indirect."

Clarence J. Grieves[3] admits: "The sterilization of dentin and cementum without destruction of adjacent tissues is the profession's greatest problem, which when solved, will save countless teeth, but it has not been accomplished as yet. . . . It may be said, with one or two exceptions, all the methods, including the latest ionic medication, are much too drastic and objectionable: to be effectively germicidal, the electric potential and dissociation, or coagulating and oxidizing elements in each, must be so high as to produce a secondary surrounding tissue necrosis, which usually becomes reinfected; a destruction of the reparative cells, but not the pathogenic element. . . . When dentin is absolutely saturated with bacteria, from long pulpal or salivary exposure or is associated with granulating or liquefying periapical invasion, its complete sterilization is questionable. After the application of all sorts of germicides, the pulp canal may be proven sterile, but if after careful extracting technique, preventing contamination, a horizontal section of the root be split, as in apiectomy, and chippings be taken from the outer areas about the granular layer, positive cultures are almost certain."

OFTEN EXTRACTION IS ONLY METHOD

Dental research is still working to find a completely aseptic method that will save the tooth and at the same time remove the focus of infection. But under present conditions, the weight of medical and dental practice is in favor of extraction if this is necessary to destroy the focus of infection.

Grieves concludes: "The writer does not agree with the oral surgeon who condemns every *pulpless* tooth; on the contrary, he knows it is possible, if the patient will present himself in time, to remove the pulp and aseptically fill *vital* root apices,

[3] GRIEVES, CLARENCE J., *J. Nat. Dent. Assn.*, August, 1918.

of a large percentage of such teeth, with no postoperative periapical infection, a fact which can be established radiographically and by cultural tests, *but he does not believe that an infected or abscessed root apex should be retained for a minute nor would he spend that time on one, unless attempting apiectomy.*"

Josef Novitzky[4] goes even further and demands more than extraction for certain conditions, even the removal of parts surrounding the diseased tooth by surgical dissection.

F. B. Moorehead[5] concludes: "Regardless of whatever form of treatment may be employed, the removal of infection is imperative in all cases, whether the patient at the time may be well or ill. . . . Where the health, comfort and usefulness of a patient are to be weighed over against a tooth, or even against all the teeth, the greater interests of the patient must be preserved."

Moorehead makes a strong point for extraction in this comment: "An interesting feature of our study of the frequency of chronic mouth infections was the discovery that the poorer classes had relatively fewer chronic abscesses than the middle and well-to-do people . . . the poor people usually have aching teeth treated by early extraction."

Arthur D. Black concludes: "The chronic focus is therefore properly considered a menace to the health, and its removal is demanded. . . . These suppurating detachments of the peridental membrane are in practically all cases permanent detachments, whether the detachment is at the side of the root or the apex. The area of bone destroyed about the apex of a root is not so important as the extent of the destruction of the peridental membrane. There is no hope of reattachment of the surrounding tissue to the root, and if such teeth are permitted to remain in the mouth—excepting those which are operated on by re-section—it should be with the definite understanding that they necessarily continue as a menace to the health of the individual and that the use of such teeth in mastication overbalances this menace to the health. . . . In such cases we are using our best judgment as to the patient's general physical condition and his resistance. We must do this with the thought ever in mind that nephritis, endocarditis, cholocystitis and other secondary effects are so insidious in their onset that the condition is likely to be serious and the patient even beyond the possibility of recovery before it is discovered by the physician."

In discussion, Dr. Black was even more emphatic: "There is a set of roentgenograms of the mouth of a patient who was under the care of a so-called pyorrhea specialist. The roentgenograms show that the alveolar process has been destroyed nearly to the ends of the roots of the upper bicuspids and molars, and these teeth are apparently being *held in place* by orthodontia appliances while they are scaled and treated. This case illustrates what I meant when I said the practice of dentistry needs to be revolutionized. Here is a mouth in which it is evident to anyone who has studied the problem of focal infections that the teeth should be extracted. The dental profession must recognize that such foci are a menace to health; then it will not be difficult to get action. The more I study these conditions, the more I am convinced that more teeth must be extracted."

NECESSITY OF DIAGNOSIS BY TRAINED ROENTGENOLOGIST

After all is said the clinical findings are inconclusive. Only the roentgenogram will define the condition about the tooth so that extraction or nonextraction may be prescribed rationally. "Good roentgenograms," Grieves says, "are rarely misleading, and it is the writer's experience that postoperative results are always more pronounced than the *x*-rays would indicate. . . . Just as soon as it can be

[4] Novitzky, *J. Nat. Dent. Assn.*, June, 1918.
[5] Moorehead, *J. Am. M. Assn.*, September, 1916.

roentgenographically demonstrated that diseased periapical regions exist as described, medication should stop and surgery begin."

J. M. Walls[7] says definitely: "It is not alone in mechanical lines that new ideas have changed the course of thought and tendencies of procedure. Perhaps nothing has arisen in the history of dentistry that has so awakened the minds of the profession as the discovery by roentgenography of periodontal infection where teeth and the surrounding tissue were by previous measures judged healthy."

Alfred R. Starr's[8] opinion is: "The roentgen rays have probably done more for dentistry than any other modern discovery. Many hidden dangers have been brought to light and many teeth, which before the application of this method would have been doomed to extraction, can now be saved. Much remains to be learned in regard to the use of this method so far as the interpretation of the pictures is concerned."

J. Melville Thompson[9] says: "As to the value of the roentgen rays in dentistry, I think at the present time dentists are scared stiff by the reports the medical men are making of their work."

F. B. Moorehead's opinion is: "Both in diagnosis and in determining the extent of tissues lost, the roentgen rays are paramount. . . ."

Thomas B. Wade:[10] "The *x*-ray diagnosis of root-canal work, fractures and foreign bodies is final. . . . The *x*-rays do not reveal to us whether there is pus or granulation tissue present."

Frank Billings[11] says: "Many roentgenographic films of the jaws have been made from patients in our clinic at Rush Medical College and at the Presbyterian Hospital, suffering from chronic arthritis. One film shows an alveolar abscess in a patient with Hodgkin's disease. These films as a means of recognition of alveolar infection are not new to members of this section, but this method of examination of alveolar disease is not sufficiently utilized by dentists and physicians generally. It should be used, for by no other method may one know the exact condition of the alveoli and roots of the teeth."

Speaking of pyorrhea, Hollis E. Potter[12] concludes: "A general survey of the denture by a series of dental films is an important adjunct to the examination of a pyorrhea case. It is often a short cut to a diagnosis and is less disagreeable than an instrumental examination, but should supplement rather than displace other diagnostic methods. The most important diagnostic points are observable in the region of the intimate bony vestments of the roots and are obtainable only from the most critical roentgenograms."

The fact that the roentgenogram is necessary to, and often decisive in, diagnosis emphasizes the importance of its being made by a trained roentgenologist.

RELATION OF THE ROENTGENOLOGIST, THE DENTIST, AND THE PATIENT

The roentgenologist will give an impartial and disinterested diagnosis and recommendation. The nub of the matter is to establish a practice that satisfies the courage of one's convictions. It is now generally accepted among the men quoted that once disease about the apex of a tooth becomes a focus of infection, it is always a focus unless it is surgically removed. No root canal treatment is established, none is even locally accepted. Although many theories are plead, and courageously and stoutly demonstrated, no one will guarantee anyone else's plan. A few will go so far as to guarantee, tacitly at least, their own, by offering it to their patients.

Surgically, there is only one solution: removal of the disease. In opposition there is practical dentistry which has to meet the following demands:

1. Freedom from the menace of the focus of infection.

[7] Walls, *J. Nat. Dent. Assn.*, August, 1918.
[8] Starr, *J. Nat. Dent. Assn.*, August, 1918.
[9] Thompson, *J. Nat. Dent. Assn.*, August, 1918.
[10] Wade, *Dental Cosmos*, August, 1918.
[11] Billings, *J. Am. M. Assn.*, December, 1914.

[12] Potter, *J. Am. M. Assn.*, February, 1917.

2. Preservation and conservation of the teeth; if the teeth are lost, there is the problem of replacement, whether by pivots or crowns or by fixed or removable bridges or by plates; these are purely dental problems.

3. The patient's desires; whether his æsthetic inclinations and idiosyncrasies will accept crowns or bridges or plates; whether his fear of advancing age is quieted by removal of the focus of infection or shocked by the removal of a tooth, and consequent artificial replacement. Many patients who do not or will not understand, prefer any putrid contraption that belongs to their chosen dentist, to a clean mouth. At the present time the dentist has more consideration for the patient's whims than the medical man has, for the latter is determined only to remove the source of infection or disease.

The roentgenologist is dealing with a fairly exact method of diagnosis and he is only concerned in arriving at the facts and giving the proper aid and information. He is free from—

1. Any pride of reputation in the previous dental work.

2. Any financial interest in future dental work.

3. He is trained to interpret and value the roentgen rays evidence, and so is in a position to appreciate the kind of procedure which will cure the disease whether this may be treatment or root amputation or extraction.

Mistakes in interpretation are always possible, but it is to be presumed he is experienced and aware of the ordinary sources of error. Dentists should be aware of the limitations of the roentgen ray examination and use every additional clinical method available. Roentgen rays are of greatest value in diagnosis. Obviously there is no other one method of equal value. If there was, it would be used and well known.

No method is equal to the graphic method of charting roentgen ray findings. (See illustration.) In this way the roentgenologist puts himself absolutely on record so that his findings can be checked up. If the dentist disagrees, he can consult by telephone as duplicate sets of films and chart are kept. As a matter of fact, rarely does a dentist do this. He is apparently satisfied. But if he intelligently differs, both he and the roentgenologist benefit by the discussion.

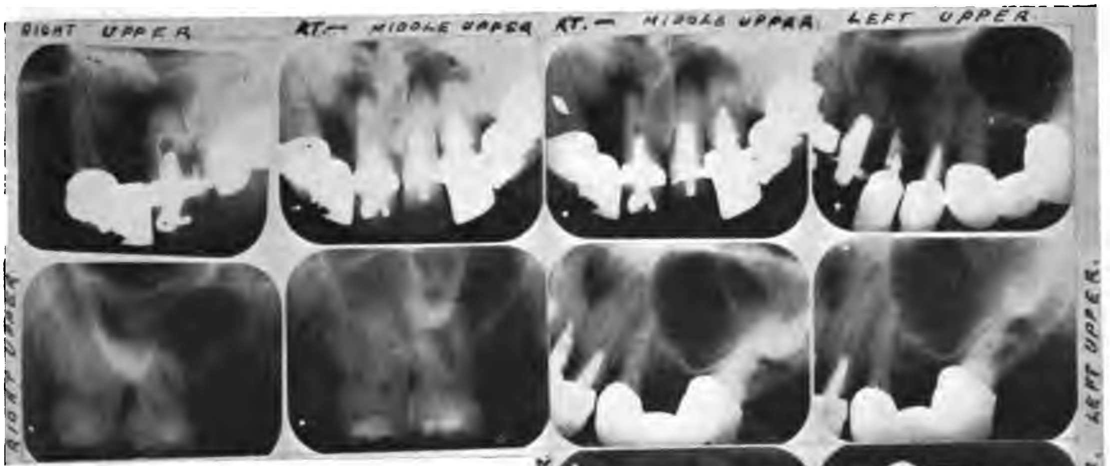
A popular use of the roentgen ray machine by dentists for this branch of their work is a great mistake for the following reasons:

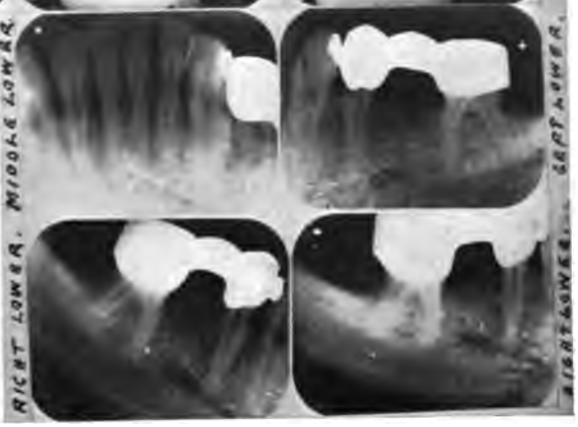
1. Few dentists can take time to perfect themselves technically so as to get clear enough roentgenograms. There is difficulty in the adjustment of the tube and in developing and drying the film, which determine the usefulness of the film. A poor film is often useless. Few dentists will be able to obtain trained assistants for this work. Roentgen ray machines should not be used without proper protection to the operator, nor should films be held in the mouth, as it is said one prominent dentist did up to only one year ago.

Granted even that he can produce good technical work, and that the dentist is able to give time and attention to get good technical work, the matter of interpretation is to be considered. This comes with experience as much as with anything else. The mere fact that a thing is a picture does not change the difference between the amateur and the expert. There are many variations of the same thing. It is experience and familiarity which give a proper sense of values . . . an entirely different matter from being able to recognize something pointed out.

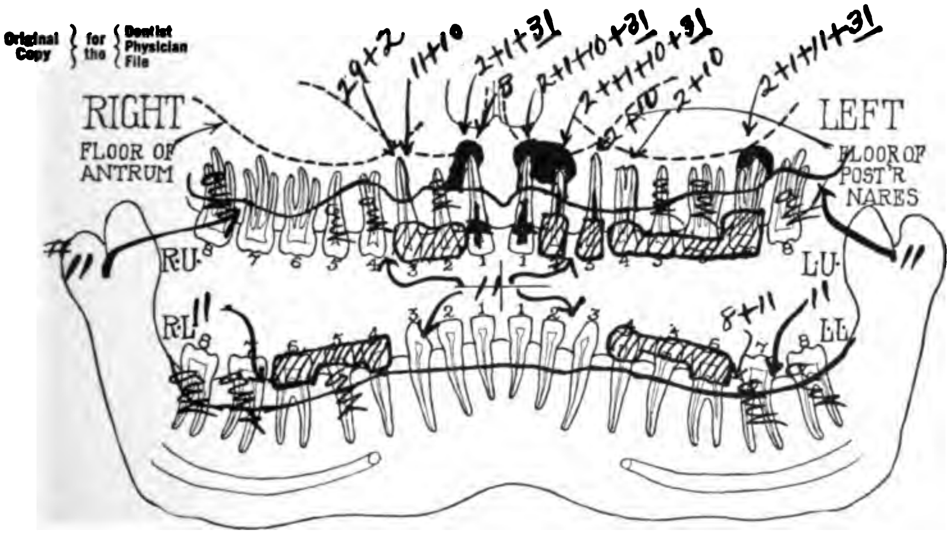
2. Another thing of no less importance is the division and sharing of responsibility. The patient has two trained men considering the question instead of one. Presumably he pays for the extra service and is entitled to the best.

3. The dentist should consider the cost of installing a roentgen ray machine, for the cost may be equal to the total cost of all his other equipment. A roentgen ray machine is not like a compressed-air blower.





This graphic method shows exactly what the roentgenologist finds. A report may also be written in detail numbering the teeth, right and left, as some persons will not take the time to study the chart, and prefer to read the findings. The dentist receives a set of films, the original chart and a copy of the report. The physician receives the set of films, the original report and a copy of the chart if he refers the case. The physician with this chart in hand can discuss intelligently with the dentist the findings and recommendations. Duplicate charts and films are kept on file so that the case can be discussed over the telephone.



1. Periapical-Alveolar abscess.
2. Canal not filled
3. Absorption of apex
4. Apex not filled
5. Apex filling projects
6. Wire-Broach in canal
7. Perforation of canal
8. Irritation, shell crown
9. Irritation, filling
10. Pericementitis (Lame teeth)
11. Alveolar Absorption—pyorrhea
12. Gingivitis
13. Cavity
14. Unextracted root
15. Fracture of root
16. Unerupted teeth
17. Supernumerary teeth
18. Impacted teeth
19. Fracture of jaw
20. Process fractured
21. Cementoma
22. Pulp stone
23. Bone "whorl"
24. Bone cyst
25. Bone tumor
26. Root in antrum
27. Antral empyema
28. Apex amputated
29. Test vitality
30. Amputate root
31. Extraction indicated 4
32.

And he would use this machine, comparatively speaking, less than any other piece of equipment. As a matter of good business, it does not pay the dentist to lay out capital for an expensive machine, which is then kept idle most of the time; it would not pay him to study a specialty which he would use very seldom—so seldom that he could not become expert in it—when he can have the services of a specialist for roentgen ray work, and the advantage of expert diagnosis to compare with his own.

Roentgenology is a specialty not to be lightly valued by the dentist. He should occupy his time with his dental work, and his roentgen ray work should be done by a competent roentgenologist.

In passing, one should mention the legal possibilities when this subject of focal dental infection becomes generally known to the laity, as it no doubt will be soon by popular articles of more or less merit. Law suits have been and no doubt will be instituted, as there is no accepted practice and standardization, eminent authorities disagreeing on almost every vital particular.

REPORTS

Proper procedure in reporting a case should protect the interests of everyone concerned and at the same time give the patient every advantage of service rendered. For example, if a physician sends me a patient, I send direct to him a set of films for the dentist, and a copy of my chart indicating my diagnosis for the physician's files, to go with the patient's other history and laboratory report. I send the original of the chart with the diagnosis indicated to the dentist. The patient has no opportunity to study the report before the dentist receives it. This is quite fair to the dentist. But the dentist is not a fixed quantity, as people change dentists from time to time, and probably more under these circumstances than ordinarily.

Now, what are the patient's rights? He has been going around to three professional men and, if he is intelligent, he will observe there is at best a spirit of restrained co-operation, and perhaps no very frank conclusion divulged by anyone. If a patient's health is at stake, should he not be aware of every suspicious tooth in his head? He may have to change dentists due to change of residence, death of dentist, or what not. He may need periodical roentgen ray examination. I believe that a *complete* solution of the problem is not attained until the patient has a copy of the chart and letter from the roentgenologist, indicating which teeth show sufficient disease to warrant extraction. Then if the patient wants to take the responsibility of retaining the tooth, the dentist is in a safe position. He is not running counter to medical opinion, nor does he benefit by the patient's inclinations or fancies to do a lot of expensive treatment or mechanical work which may eventually be more of a curse than a blessing. The dental profession has been all through this already; the fair-minded ones admit their mistakes but many still pursue their accustomed ways or with only slight changes.

More frankness and co-operation will wear out the routine grooves so that this vital matter can be handled entirely in a constructive manner. Everything in medicine or dentistry points to a *united* practice.

CERTAIN TEETH TO EXTRACT IN PERIAPICAL ABSCESSES

In an apical abscess, the question arises whether the extent of the danger may be estimated by the size of the abscess, and if not the size, then what factor may determine the danger. The size is not an indication of the extent of the danger present.

However, although the size has no bearing on the danger, it might seem to have a bearing on the possibility and method of treatment; and the smaller the abscess is, the easier it would seem to treat, if it is decided to treat the tooth.

If the pericementum is not gone, and the apex is not stripped, natural repair

might take place even though no treatment at all is given. The correct procedure would be to empty the canal aseptically, to try to sterilize it, and to refill it aseptically. But it is never possible to be sure that the process is completely aseptic.

If in the course of this procedure it has not been re-infected, the natural processes of repair will repair the periapical disease.

But an abscess of any considerable size or any definite area of disease, means the tissues are in the presence of infection and the only satisfactory treatment is surgical treatment, e.g. root amputation. This applies to any loss of bone more than the width of a line, presuming that a simple pericementitis may recover through restoration of itself, leaving fibrous tissue to form the union between the alveolar process and the tooth.

But if the tooth is a dead tooth, it is said there can be no repair from the canal side, as the nutrition of the tooth circulates between the pericementum outside and the lymph and blood supply inside. It is obvious that if either side disappears through disease, nutrition is impaired if not lost and the tooth becomes at best an aseptic foreign body. Now if the dental tubules are infected, as established by Price and others, the foreign body is septic and so must be extracted or amputated.

WHEN TO EXTRACT IN PYORRHEA

Pyorrhea or peridontoclasia is a general name applied to any destructive disease of the alveolar process whether there is macroscopic pus or not.

If the disease extends from the margin of any considerable alveolar absorption on one side around the apex to the other side of the tooth, as shown by the black line indicating pericementitis, such a tooth should be extracted for it is probably worse than the roentgen rays show.

But if the tooth shows consideralbe alveolar absorption yet is still sound on its apical one-third, such a tooth may be saved by intelligent surgical treatment for pyorrhea and should be left. This surgical treatment is now a specialty in dentistry for the peridontist or pyorrhea specialist. It is only a question of time: if disease is *not arrested*, the tooth will be lost. Much loosened teeth should always be extracted if treatment is not effective.

In pyorrhea the roentgen ray is of equal value as in apical abscess for showing peridontoclasia or absorption of bone of the alveolar process by disease. A roentgenological survey of the teeth will show an extent of disease that is often impossible to diagnose by clinical examination and will be a guide for instrumentation of the pockets and correction of shell crown and filling irritation so often the cause of the trouble.

Malocclusion as a cause of pyorrhea is purely a problem for the dentist.

Nor does the film show only the disease between the teeth, for proper films will show the pockets in the gingival and buccal margins.

CURETTING

It would seem, in the light of one's experience, that after the granuloma or abscess is broken up by the extraction repair would take place without curetting the remaining wall of the abscess.

In fact, the abscess being already walled off, it would seem to be bad practice to carry infection deeper, and while there is a tendency to advocate curetting, the practice might be abandoned for the old, tried, common method of extracting the tooth only. The writer has never seen in the film any evidence of disease in the bone where complete healing of the gum had taken place. This in itself would be sufficient evidence that there was no infection below unless some other tooth was at fault.

There are many dangers to be met in curetting: in the upper jaw the adjacent nerves may be injured, the antrum may be entered, and disease may be extended by breaking through the walled-off area.

In the lower jaw, adjacent nerves may be injured, the inferior dental canal may

be entered, and extension may be carried through the broken-down, walled-off area.

The extracted tooth offers free drainage and from time immemorial this practice has been sufficient. Why assume the responsibility of introducing this radical operative interference?

CONCLUSION

Dr. Harold S. Vaughn's conclusions on this subject offer a good summary of proper practice: "I consider the roentgen ray indications a fairly definite working basis for extractions and root amputations though nearly all cases should be checked up by a careful examination of the mouth and teeth as occasionally a non-pathological rarefied area or a foramen may appear in the film like a definite focus of infection; or conversely, we sometimes see black infected teeth that show little periapical change due to the fact that they drain through a thin bony layer to the surface, and thus we do not get the destruction of bone as in the case of walled-in infections. The diagnosis should be based primarily on the roentgen ray findings tempered by the clinical experience gained by the study of roentgen rays of other cases where the teeth and infected tissues had subsequently been removed giving a chance for comparison.

"My own observation leads me to believe that only a small number of teeth showing periapical infections can be completely cleared up by canal sterilization and filling; and they are the ones in which the tissue in this area is a semi-organized granuloma without destruction of the pericementum around the apex or a breaking down and liquefaction of the contents.

"Another class of cases can be cleared up by amputation after sterilization and complete filling of the root canals. These are the ones that have a destruction of the apical pericementum, erosion of the root apex surrounded by an organized lining membrane with liquid contents,—assuming that the destruction is not too great.—Amputation is not advisable for posterior teeth except in selected cases.

"Extraction followed by surgical removal of the infected area is indicated in the vast majority of teeth showing periapical infection and the routine conservative methods at present fall far short of the requirements in the removal of foci.

"I believe that it is almost impossible to carry out successful root canal treatment in the army even where they would be indicated in civil practice as the work is done under unfavorable conditions except possibly in some base hospitals."

GAS GANGRENE OF THE LEG DUE TO B. WELCHII

REPORT OF A CASE DIAGNOSED ROENTGENOLOGICALLY

BY FRED A. SPRAGUE *

Captain, M. C., U. S. A.

CAMP ZACHARY TAYLOR, KY.

FRED ——, white, civilian, age 15 years, a native of Elizabethtown, Ky., was admitted to the base hospital, Camp Zachary Taylor, Ky., on the evening of April 8, 1918.

Previous History.—Negative.

Present Illness and Cause of Admission.—Patient was watching a machine gun, April 6, 1918, while standing on the Court House green at Elizabethtown. The gun was accidentally discharged, the patient receiving the ball through the left knee joint. The wound was dressed and cared for by a local physician until April 8, when the patient was admitted to the base hospital.

FIG. 1. SERIES I. MADE 8.30 A.M., APRIL 9, 1918.

A physical examination at this time showed a gunshot wound in the left knee, the wound of entrance being just below the patella, that of exit being four inches below this on the back of the leg. There was a foul discharge from the wound and the leg was swollen. The foot was cold, and discolored up to the ankle. The temperature was 102, pulse 140, and respiration 32.

On the following day, April 9, the discoloration extended to within four inches of the knee. B. Welchii was positive in both the smear and culture of discharge from the wound. An injection was given of 3.5 c.c. B. Welchii antitoxin and the extremity was amputated by guillotine operation at upper third of the thigh on April 9 at 2.30 P.M.

On April 10 the temperature dropped to 99, the pulse to 110, and the respiration to 20.

Postoperative History.—The stump was treated with Dakin's solution, but a second amputation had to be performed to secure a proper stump. After that, convalescence was uninterrupted and the patient is in good condition at the present writing.

The first roentgenogram, Series 1, was made at 8.30 A.M., April 9, about seventy-two hours after the accident. It shows a very considerable infiltration of gas in the tissues, involving the lower third of the thigh and all of the leg and foot up to the metatarsal bones. The accumulation of gas is most marked posterior to the upper third of the fibula where it evidently dis-

* Authority to publish granted by Board of Publication, Surgeon General's Office, Washington, D. C.

sected its way down from the knee joint. It is plainly visible in the tissues beneath the plantar fascia as shown on the original plates, but this part, unfortunately, was not printed. The soft tissues of the knee

FIG. 2. SERIES II. MADE 1.30 P.M., APRIL 9, 1918.

are shown somewhat swollen, and those just below the patella much distended with gas which almost obliterates the tissue outline. A diagnosis of gas infection, confirmed later by the surgeon and the pathologist, was made from this plate.

Series 2 was made at 1.30 P.M., April 9, about five hours after Series 1. In these plates the progress of the infection is quite evident. The thigh is involved up to the upper third, and the accumulation of gas in the soft tissue obscures the structure of the femur.

Series 3 was made twenty-four hours after amputation at 3.30 P.M., April 10. The organism continued to proliferate after separation of the part and the resulting gas so distended the soft tissue as to make their structure very dimly visible.

Pathologist's Report.—Left leg and lower part of thigh: the leg from the knee downward shows greenish discoloration and is very malodorous, in spite of the fact that it has been kept in a four per cent solution of formaldehyd for the past five days.

The résumé of the finding is as follows:

1. The tissues of the thigh showed no gangrene nor inflammatory changes, appearing healthy in every way.

2. The tissues of the leg showed marked inflammatory changes, having a parboiled appearance.

3. The knee joint was distended with a dark, somewhat frothy, bloody fluid. Smears from this fluid show fairly well-

FIG. 3. SERIES II. MADE 1.30 P.M., APRIL 9, 1918.

preserved red blood cells, and a large number of Welch bacilli.

4. The cartilages of the knee joint and the bony articulations were normal in every way.

5. The immediate neighborhood of the gunshot wound was converted into a greenish-black gangrenous mass.

6. The sciatic nerve in this region was of a greenish-black color and softer than normal. About 10 cm. below the region of the gunshot wound it was of normal color and firm consistency.

7. The femoral artery was uninjured and free from any thrombus or embolus.

8. The femoral vein was ruptured in the region of the gunshot wound. This injury may have been caused by the post mortem operator.

9. In the sheath of the large vessels, for about 10 cm. upward, and for about twice this distance downward, a slightly frothy, dark red, bloody fluid existed. From the appearance it might be judged that, during life, this material caused compression of the vessels.

10. To a less extent similar bloody material existed in the muscle sheaths down the leg.

11. Ten days after amputation, although the leg had been kept in a four per cent solution of formaldehyd, smears still showed B. Welchii, thus proving the viability of the organisms.

Fig. 4. Series III. Made 3.30 p.m., April 10, 1918.

Fig. 5. Series III. Made 3.30 p.m., April 10, 1918.

Summary.—This case demonstrates well the certainty with which a diagnosis of gas gangrene can be made by the roentgen ray. It also shows the extentto which the infection progressed within six hours. It is my opinion, in which Colonel Welch, of the Surgeon General's Office, concurs, that within twelve hours after the entrance of a foreign body, the gas infection resulting therefrom can be recognized. It will be confirmed within six hours afterwards by another plate which will show considerable progress. Colonel Welch states that Colonel Bull reports that the result of infection from gas bacillus begins within twelve hours, and extends considerably within six hours thereafter. This six-hour progression can be demonstrated by the roentgen ray plate. It is therefore advisable, and is a definite rule of the hospital, that each case of injury with a foreign body in the tissue be followed up with six-hour plates until gas infection can be certainly excluded.

I am under obligation to the Surgical and Pathological Departments of the Camp Zachary Taylor Base Hospital for the accompanying data.

MECHANICS OF THE STOMACH AFTER GASTRO-ENTEROSTOMY

BY JOHN T. MURPHY, M.D.

TOLEDO, OHIO

THE following are a series of observations upon 25 cases in which gastro-enterostomy was performed for ulcer of the stomach or duodenum. The cases were taken from our records and no effort at selection was attempted. The object of the examination was to help the surgeon in the proper location and size of the gastro-enterostomy opening.

In doing this several main things were kept in mind. What becomes of the new opening in a stomach after gastro-enterostomy? Does it functionate in the presence of a patulous pylorus? Is it always necessary to occlude the pylorus after gastro-enterostomy is performed? Is gastro-enterostomy a drainage operation? Do such artificial occlusions remain permanently closed? Upon all of these questions there is as yet little unity.

All of the cases in this series were cases of ulcer of the stomach or duodenum, and in every case a posterior gastro-enterostomy was performed. The methods employed were the same as are used in an ordinary gastro-intestinal case. A pint to a quart of buttermilk, in which were mixed four ounces of mucilage of acacia and from two to four ounces of barium sulphate, was given the patient in the upright posture. Four hours were allowed as the normal time for the emptying of the stomach of this meal. The vertical fluoroscope was used in the preliminary examination to determine the position of the opening, the shape, size and position of the stomach. In the examination of the pylorus and of the duodenum, if shown, the right lateral prone position was used. The ages of the patients examined were from 25 to 60 years. The length of time since the operation was as follows:

Less than six months	6
Over six months but less than one year	6
Under a year and a half but over one year	6
More than two years	3
More than four years	1
More than six years	1
Date unknown	2

In many of these cases no difference in the filling of the stomach was noted. In others the rapidity with which the food left the stomach prevented it from filling

except in part. In several cases, the entire organ filled just as in the normal, including the pylorus, and then the opening began to functionate and allowed the food to pass rapidly into the small bowel. In these cases, even though the pylorus was patent, only a very small amount passed out in the normal way in the upright position. In a certain number of these cases the food left the stomach rapidly, until only a small amount remained along the greater curvature of the stomach, with a corresponding amount in a loop of the jejunum. This remained for some time, but in only one case did this stasis persist long enough for it to be of pathological significance. In this case, a posterior gastro-enterostomy, number 21 of the list, the anastomosis was made parallel to and high up on the greater curvature. The pylorus was sutured and remained closed. The food ran out of the new opening very rapidly until its level was reached, then it emptied slowly, leaving a residue at 24 hours. This case had very severe symptoms, pain, feeling of heaviness, gas eructations and vomiting and the patient was very miserable generally. In only four of the cases of this series were the patients not uniformly well. In all but one of these four, the reason for the recurrence was found at the fluoroscopic examination. In case number 20 the gastro-enterostomy was functionating perfectly, emptying the stomach in two and one-half hours, with nothing but the slightest delay in the jejunum to account for the symptoms. The stomach was spastic which suggested that possibly the ulcer had never healed. A positive Wassermann reaction with an amelioration of the symptoms following anti-syphilitic treatment established a diagnosis of gastric crisis. This has been substantiated by the progress of the spinal disease since the examination. In number 23, because of a complete recurrence of pain and distress 18 months after the gastro-enterostomy, the patient applied for re-examination. An irregularity of the pylorus suggested carcinoma although the new opening was functionating well. Reoperation revealed a carcinoma of the pylorus engrafted upon the ulcer site. This caused the death of the patient. Case number 21 had a recurrence of pain after meals about six months after the operation. Upon examination stasis was found to occur posterior to the stomach and, after careful study of the barium movement, we believe that an extra loop of jejunum had been included in the operation, causing a stasis at this point with distention of the bowel which continued some time after the stomach was empty. No subsequent operation has been performed so we have no operative confirmation.

We have deduced from the above data:

That patients having gastro-enterostomy operations properly performed are uniformly well.

That a patent pylorus does not interfere with the function of a properly placed gastro-enterostomy opening.

That the opening must be of sufficient size placed at the lowest point and almost directly below the lesser curvature of the stomach.

That openings so made remain open permanently.

That it is not a necessity but a good surgical procedure to occlude the pylorus, thereby causing the stomach to empty, at least temporarily, by the gastro-enterostomy opening.

That gastro-enterostomy is a drainage operation.

That in no case have we ever been able to demonstrate serious distention of the loop of a small bowel near the opening into the stomach.

That regurgitation of food back into the stomach does not seem to make any difference in the results of the operation.

That ulcer diet should be used after the operation. That liquid food, by preference cool liquids, leave the stomach with the least peristalsis. That all gastro-enterostomy patients should eat frequently and a less quantity of food at each meal.

TABLE OF CASES

No.	Age	Sex	Time since Operation	Treatment of Pylorus	Peristalsis	Emptying Time	Stasis in Small Bowel	Type of Stomach
1	55	M	9 months	Not closed	None	4 hours	None	Normal
2	42	M	5 months	Closed	None	3 hours	Slight, near stomach all clear in 2 hours	Hypertonic
3	38	M	8 months	Excision of pylorus	Normal	4 hours	None	Hypotonic
4	46	M	21 months	Closed	None	1½ hours	None	Normal
5	35	F	17 months	Not closed	None	½ hour	None	Normal
6	55	M	11 months	Closed	None	4 hours	None	Hypotonic
7	23	M	2 months	Partial closure	Deep	2 hours	None	Hypertonic
8	50	F	3 months	Partial closure	None	1½ hours	None	Hypotonic
9	45	F	11 months	Not closed	None	5 minutes	None	Hypertonic hour glass spasm relaxed at 2 hour examination
10	36	M	32 months	Partial closure	Normal	1½ hours	None	Normal
11	46	F	4 years	Not closed	None	5 minutes	In loop near terminal ileum	Hypertonic
12	28	M	14 months	Closed	None	30 minutes	None	Normal
13	30	F	2 months	Partial closure		2 hours	None	Not noted
14	35	M	2 months	Not closed		2 hours	None	Normal
15	36	M	29 months	Not closed	None	4 hours	None	Normal
16	35	M	2 years	Not closed	None	1 hour	None	Hypotonic
17	55	F	3 years	Partial closure	Normal	4 hours	None	Normal
18	39	M	16 months	Closed	Normal	2 hours	None	Hypotonic
19	55	F	26 months	Closed	None	2½ hours	None	Normal
20	30	F	Not known	Not known	Increased	2½ hours	In jejunum	Hypertonic
21	25	F	10 months	Closed	Normal	2 hours	In jejunum behind stomach	Hypertonic
22	40	F	Not known	Closed	None	Residue 24 hours	None	Normal
23	60	M	18 months	Closed	None	2½ hours	None	Normal
24	45	M	6 years	Closed	Normal	2 hours	None	Normal
25	35	M	5 months	Closed	Increased	2½ hours	None	Hypertonic

A ROENTGENOGRAPHIC STUDY OF OSTEITIS DEFORMANS—PAGET'S DISEASE

BY C. WINFIELD PERKINS, M.D. *

Captain, M. C., U. S. A.

NEW YORK CITY

PAGET'S disease of the bones, so named after Sir James Paget[1], whose papers were read and published in 1876, is not as rare a malady as one would suppose, considering the meager literature on the subject and the lack of general knowledge of the disease as evinced by the profession at large. Abbe[2] of New York, in a recent article refers to the name given in the German textbooks as "*osteomyelitis fibrosa.*" This he states is a "clinical delusion" so far as the name is concerned, as a fibrous change in the bones is nowhere to be found, but a bony hypertrophy or overgrowth is especially illuminated on the roentgenogram. Regarding its distinctive pathological processes as mirrored on the roentgen plate, the name is, therefore, misleading and illusionary.

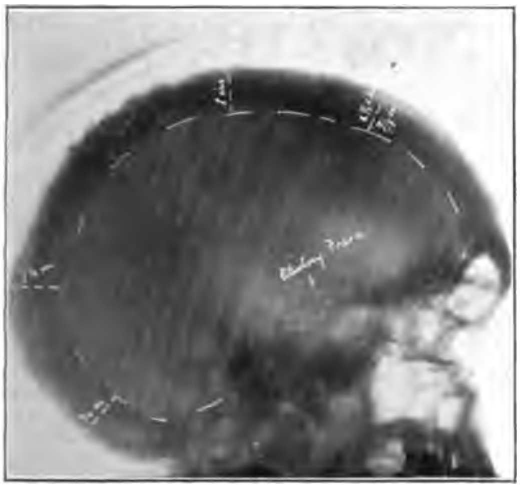


FIG. 1. LEONINE TYPE OF SKULL WITH THICKENED INNER AND OUTER PLATES. The moth-eaten appearance is due to porosity of the outer plate. The sella turcica is small, measuring 10 x 10 mm. (normal 12 x 15 mm.). There is a shadow which suggests a calcareous roof over the pituitary fossa. The frontal and maxillary sinuses simulate acromegaly in that they are large, having a blown out appearance. The posterior portion of the spheroid is unusually dense.

FIG. 2. CHEST WITH THICKENED CLAVICLE AND RIBS. INCREASED DENSITY OF THE HILA SHADOWS WITH CALCAREOUS CHANGES.

The etiology is in a stage of conjecture, there being several theories but nothing of a positive nature. Goldthwait[3] suggests as a cause, some interference with metabolism affecting the shafts of bones, that is, some loss in balance between waste and repair, perhaps brought about by hypersecretion or hyposecretion of some glandular tissues of the body, thereby interfering with the normal bone-forming or bone-destroying mechanism. Cushing in his monograph states, that "in every case of increased intracranial tension from whatever source, there probably occur secondary changes in the hypophysis, often with gross deformities and resultant functional disturbances, which frequently elicit recognizable clinical manifestations." This

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patient (Fig. 1) complained of headache which is an early signal of intracranial pressure. In view of the above statements, the fact remains that the roentgenogram demonstrates a small, undersized pituitary fossa, which is bridged over with a sclerosed roof. This, in turn, is associated with a dense posterior sphenoid sinus. There is food for thought in such observations. We immediately think of the possibility and significance of hypopituitarism in its relationship to the etiology of this disease. This patient, as in nearly all cases of osteitis deformans, has the clinical appearance of hypophysis involvement as shown in the small stature, large head, prominent frontal and maxillary sinuses (blown out type), bowed extremities, and the general physical make-up of pituitarism. Up to the present time, the writer has been unable to find any roentgenological literature referring to the subject, though the matter has been hinted at by several well-known clinicians without the roentgen data.

Fig. 3. The Bones of the Left Arm Are Slightly Denser Than Normal.

Fig. 4. Right Arm with Thickened Dense Lower End of Radius.

The patient has a small pituitary fossa as compared with the size of the skull and normal averages from recent studies made by the writer[4] and others, on the normal pituitary fossa. In this case (Fig. 1) it measures 10 x 10 m, whereas the normal average is about 12 x 15 m, accounting for the normal variances.

The French school of clinicians represented by André Chastel[5] is inclined to view the etiology on a basis of syphilitic hereditary hypothesis. The reports of Lannelogue before the Academy of Medicine, Paris, 1903, give various discussions. In one instance, of 61 cases of Paget's disease one was due to basic syphilitic heredity. It is perfectly logical to assume that any pituitary involvement could be secondary, as a result of a primary disease, especially as this patient has had a syphilitic history and recently a mild, positive Wassermann. Therefore the pituitary or glandular theory as suggested by Goldthwait[3] seems strongly indicated in the study of this patient.

It may be fairly stated that it is not a

disease confined to any one of the bones, for the various bones are likewise affected in the generaly hypertrophy of the osseous tissue. Morton Prince[6], in an able article, speaks of the pathology of this disease as divided into three separate divisions, namely, (a) absorption of bone; (b) new formation of bone without calcification, and (c) new formation of bone with calcification. Any one pathologic process may predominate. The growth is slow and any portion of the body may be affected, from the head downward. The head and the bones of the extremities, especially the tibia, are pointsof election for definite pathologicalp rocesses, though the other bones of the economy are involved as shown in the accompanying roentgenograms (Fig. 2) namely, the clavicle, ribs, radius, phalanges, lumbar spine, femur and hip bones. The distinct prominence of the frontal and maxillary sinuses are strongly suggestive of pituitarism, being acromegalic in appearance.

The bony hypertrophy assumes an ivory-like consistency in some cases, and in making a roentgen exposure requires much longer time to penetrate the structure for the impression on the plate than the same portion of the anatomy in normal subjects.

Hayhurst and Hartung[7] in their report of two cases in 1911, by the roentgen method of examination describe not only the above characteristics, but in addition, a general arteriosclerosis in the upper and lower extremities, as shown on the roentgenogram. They also report normal sella turcica or pituitary fossa. In this patient no sclerosed changes have been noted in the arteries, but a small pituitary fossa roofed in with sclerosed changes, is significant.

Fig. 6. The Left Tibia is Thickened and Presents a Moth-eaten Appearance in the Upper Half. The Bone is Decidedly Bowed. The Periosteum is thickened. The Fibula is normal. The Right Tibia and Fibula Appear Normal with theException of a Slight Increase in Density.

Fig. 5. The Bones of the Left Hip-joint Are Dense. Note especially the femur.

It may be interesting to note that the first roentgen examination of Paget's in France, was made by Gallois in 1901, at the Béclère Institute in Paris. As a method for pathological study of bone "in vivo," the roentgen-ray is unsurpassed for accurate observations of the osseous changes throughout the body.

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AUSTIN LATTING HOBBS

Dr. Austin Latting Hobbs was born at Peterton, Kansas, January 18, 1882. He was graduated from Princeton in 1907, and from the College of Physicians and Surgeons, Columbia University, in 1911. At the time of sailing for France he had an office at 11 East 48th Street, New York City, and was Roentgenologist to Roosevelt, Park and Volunteer Hospitals.

Dr. Hobbs was commissioned a First Lieutenant in the A. E. F., and sailed for France with the Presbyterian Hospital Unit in May, 1917. He was stationed at Base Hospital No. 1, A. E. F., at Etretat, France. He died at St. Mesnil, France, on September 26, 1918.

Mrs. Christine Terhune Herrick, whose son was Doctor Hobbs' most intimate friend in college, says: "From the first I

was impressed by his stability of character, and this impression grew as I knew him better. He was a boy absolutely to be relied upon, of entire integrity, steadfast, a firm friend and one of whom those who knew him could always be sure. As he grew into manhood these qualities continued and

were his most striking characteristics. He was genial and ready for enjoyment but there was always the background of strength, courage and trustworthiness that was felt by all who knew him.

Colonel George E. Brewer mentions the splendid work of Dr. Hobbs at Etretat and speaks of his great popularity not only in the hospital but in the village as well. He was very much interested in the orphans and children, and it was largely through his efforts and those of Mrs. Hobbs that a Christmas celebration for the whole village was held.

Dr. Hobbs was detailed to study the work at A. E. F. Evacuation Hospital No. 1, and Mobile Hospital No. 3 in the front area. It was during this work that he contracted influenza which developed rapidly into pneumonia which caused his death at the age of thirty-six. BYRON C. DARLING.

PAUL MORGAN STROTHER

Dr. Paul Morgan Strother of Lynchburg, Va., a member of the American Roentgen Ray Society since 1915, was injured in an automobile accident on November 25, 1918, and died as a result of the accident the following day.

He was born of a prominent Virginia family on April 29, 1884, in Lynchburg, Va., and received his early education at the public schools of that city. For one year he attended the Virginia Polytechnic Institute, then entered the Medical Department of the University of Virginia, from which he received the degree of M.D. in June, 1906.

Following his graduation, he established himself in the town of Scottsville, Va., and pursued the general practice of medicine for about six years. Then he determined to take up roentgenology as a specialty and came to Richmond, where he was associated with the writer in the capacity of student and assistant for more than a year. In 1914 he settled in Lynchburg, his native city, limiting his work to roentgenology.

From the beginning his ability was recognized, and he rapidly attained a position at the head of the medical profession of that city. At the time of his death he was President of the Lynchburg Academy of Medicine, which comprises the City of Lynchburg and the County of Campbell. In addition to membership in his local society, he was a member of the Medical Society of Virginia, the American Medical Association, and the American Roentgen Ray Society. Rarely has one of so brief an experience attained such a degree of excellence in this branch. His work has been recognized as of the best type, and his opinions were thoroughly reliable.

Dr. Strother had been active in Red Cross work and had planned to volunteer for service in the Medical Corps of the Army. He was arranging to do so when the armistice was signed.

In the death of Dr. Strother the profession of Lynchburg and of the State of Virginia has sustained a loss difficult to refill. He leaves a wife, who was Miss Elisabeth Bradley of Crosswicks, N. J., and one child, a daughter of two years. He is also survived by his mother, a sister, and two brothers. ALFRED L. GRAY.

NOTICE OF MEETING

The Twentieth Annual Meeting of the American Roentgen Ray Society will be held at Saratoga Springs, N. Y., on September 3, 4, 5 and 6, 1919. Reserve this date and make plans to attend. Details will be published in later issues.

TRANSLATIONS & ABSTRACTS

Novitzky, Josef. Devitalized (dead) Teeth. (*J. Nat. Dent. Assn.*, Vol. 5, June, 1918, p. 555.)

Injury to other parts of the body is commonly due to devitalized teeth and the treatment and retention of dead teeth in the jaws. Devitalized teeth in which putrefactive changes have taken place should be removed from the jaws not by ordinary pulling or extraction but by surgical dissection. Areas of disintegrated bone or new growth tissue at the root ends of dead teeth cannot be adequately treated through the root canals of the teeth. The old method of extracting will not remove all of the diseased area; blind curetting after extraction may be helpful or it may be harmful. In extraction, such complications as antral perforations, necrotic antral walls, or polypi will probably not be discovered.

It is questioned whether it is possible to retain dead teeth in which putrefactive changes have not taken place. Putrefactive changes may be retarded in a tooth, but appear after a few years. It is concluded from cases observed that every devitalized tooth will in course of time become putrescent. Therefore no tooth should be devitalized.

When devitalization cannot be prevented, immediately after devitalization a dead tooth may be extracted without danger to the patient. Then, a devitalized tooth should be immediately extracted; but if the devitalized tooth has been allowed to remain in the jaw, surgical dissection is necessary to remove infection.

Black, Arthur D. Abstract of Discussion of Symposium on Mouth Infections. (*J. Am. M. Assn.*, Vol. LXIII, Dec. 5, 1914, p. 2029.)

The two groups of chronic foci, the chronic alveolar abscess and the so-called pyorrhea pocket, involve the peridental membrane; there is a suppurative destruction of the tissue of the cementum covering the root of the tooth; and the cementoblasts, the only cells which could cause reattachment of that tissue, are destroyed. All the specialized elements necessary to the connection of root with bone are lost, and reattachment of the tissue to the cementum of the root is impossible. The roentgenogram shows this very clearly. Careful examination will show a line down the side of and close against the root, which is practically always in advance of destruction of the tissue elsewhere. Microscopic examination of sections confirms this view. Pockets remain about such teeth and the underlying tissue is subject to frequent reinfection. The dental treatment indicated is the elimination of the focus in alveolar abscess by resecting the denuded root end, or the extraction of the tooth. If it is a pocket alongside the root, exposed to the fluids of the mouth, the tooth must be extracted or palliative treatment employed which will be effective against reinfection.

Potter, Hollis E. The Roentgen Ray in the Diagnosis of Pyorrhea. (*J. Am. M. Assn.*, Vol. LXVIII, Feb. 10, 1917, p. 417.)

The exact technic necessary in periapical disease is not needed in pyorrhea. In pyorrhea the *x*-ray can bring to light some of the minor changes about the roots of individual teeth; for this, only the most critical roentgenography with careful and intelligent reading is of value. Whether the erosion lies on the labial, buccal, or lingual aspect cannot be judged from a roentgenogram, even if a double line is present. The most accurate portrayal is obtained by the stereoscopic method. The roentgenogram should be made at a considerably lower angle than for demonstration of the apexes. The general line showing the ulcerative process will usually show clearly in the region of the septal bone.

Limitations in the value of the *x*-ray findings occur sometimes, *e.g.* when a loose pyorrhea tooth does not show the expected well-defined findings, because the atrophy is probably diffuse; or a pocket may be shown around a firm tooth. In an ulcerative process in which bone shadows show partial decalcification, the process is in an active stage; in well demarcated cases, the process may be considered more chronic in type.

MOOREHEAD, FREDERIC B. The Prevalence of Chronic Mouth Infections and their Management. (*J. Am. M. Assn.*, Vol. LXVII, Sept. 16, 1916, p. 845.)

Of 718 cases cited illustrating incidents of chronic mouth infections in three groups of cases 498 were chronic arthritis; 70 were chronic infections but not suffering from joint lesions; 150 were referred for examination because of some systemic disease. Alveolar abscess occurred in 89%, 74%, and 69% of these groups respectively.

Chronic alveolar abscesses may be classified as primary and secondary: primary, those in which infection occurs through the root canal from an infected pulp; from faulty technic in root canal treatment; and from failure to properly seal the root canal and pulp chamber in introducing permanent filling materials. The secondary infections are blood borne, the predisposing cause being a lowered resistance in the periapical tissue brought about first by the careless use of arsenic as a devitalizing agent and secondly, by the indiscriminate use of irritating agents in the treatment of root canals.

In pyorrhea and root abscesses, conservative measures may be adopted, the extent of involvement of the peridental membrane being the decisive factor in choosing between conservative and radical treatment. The focus of infection must be removed, whether the patient is well or ill. Not more than 25% of the root canals treated may be considered safe, and not over 10% of dentists are competent to undertake difficult root canal operations. It is the lesser of two evils to remove the tooth.

The roentgen ray is the decisive method in diagnosing and in determining the extent of tissues lost. A large granuloma may involve only the spongiosum, and where the external bony plates are thick and dense, the roentgen ray will not define the area. When conservative measures are decided on, the roentgen ray should be used to check up the process of repair.

WADE, THOMAS B. Interpretation of Roentgenograms. (*Dental Cosmos*, Vol. LX, Aug., 1918, p. 695.)

The clinical diagnosis should always precede and should be confirmed or rejected by the roentgen ray diagnosis. The roentgenographic analysis is quantitative rather than qualitative, is accurate for boundaries but indefinite for specific names. The roentgen ray diagnosis of root canal work, fractures, and foreign bodies is final. It does not reveal whether pus or granulation tissue is present. Diagnosis depends on the comparison of the possible pathological tissue with normal tissue.

Diseases of the dental pulp show two varieties of pathological changes: (1) A suppurative inflammation ending in an acute alveolar abscess, characterized by pericementitis, does not show on the film because there is no destruction of the bone. (2) A proliferative pericementitis or the granuloma, which is symptomless, can usually be diagnosed by the roentgen ray. The film of a granuloma shows a clearly circumscribed area. Roentgen ray of a cyst shows a large dark area with a definite border, but from a roentgenogram one cannot differentiate between a large abscess area and a cyst. The operation, however, is the same. The roentgen ray reading of a chronic alveolar abscess in most cases shows a shading off from the dark area into the light or surrounding tissues. Blind abscesses show about the same reading as chronic abscesses, except that there is no protecting membrane between the pus and the blood stream. From a roentgenogram we cannot differentiate between a blind abscess and a chronic abscess, and in some cases between a chronic abscess and a granuloma.

A necrotic area shows a honeycomb appearance. When the root apex is absorbing, surgical means must be employed. It is impossible to differentiate between syphilitic, arsenical, phosphoric, or tubercular necrosis; diagnosis depends on the history, clinical diagnosis, and blood test.

NOVITZKY, T. JOSEF. Notes on Radiographs and the Surgical Treatment of Septic Teeth and Alveolar Process. (*Dental Items Interest*, Vol. XI, Jan., 1918, p. 35.)

In spite of the diagnostic help which the roentgen ray has been in dentistry, many men refuse to accept it or they minimize its value. Value of the roentgenograph is not seen because ability to interpret it depends on experience and mature judgment. Roentgenography should be used in conjunction with clinical findings. Errors in roentgenography are generally due to the mental equation of the diagnostician. All

extractions of dead teeth should be preceded by roentgenographic study to establish pathological conditions. Technic of dissection followed by curettement should be used. The roentgenograph indicates areas of disintegrated bone which often result in secondary systemic lesions. Necrosed alveolar processes showing no local symptoms but resulting in systemic symptoms are indicated by the *x*-ray. In many pyorrhea cases, the roentgenograph will show bone sepsis. Cases show that arthritis, tonsillitis, and Bell's palsy are relieved by dental operations following roentgen-ray diagnosis of septic oral areas.

GRIEVES, CLARENCE J. The Clinical Status of the Gingivo-Peridental and Dento-Alveolar Infective Focal Portals. (*J. Nat. Dent. Assn.*, Vol. 5, Aug., 1918, p. 775.)

Accurate intra-oral roentgenographs, with not more than two teeth in focus at any time, and occasionally extra oral plates, are necessary to arrive at a correct diagnosis of damage to adjacent dental tissues or calcific pulpal changes, etc. Even in the dental profession there is no agreement on the interpretation of these roentgenographs.

The professional roentgenographer's findings as to teeth cannot be trusted. The appearance of the dental foramina approaching the inferior bicuspids apices is interpreted as infective erosion or rarefaction; the eruptive tooth crypts of superior laterals, which often persist with open trabeculæ, as well as those in which the second and third molar apices appear to lie, are often reported as rarefactions. In this way, normal teeth have been lost. The roentgenograph amounts to little without the judgment of a dental specialist.

There are several fixed diagnostic features, dependable in interpretation: the character and stability of the hard lining of each alveolar socket, and the atratum durum or lamina dura, showing as a dense line. Its disappearance, together with the supporting trabeculæ in the gingival third, marks the deepening gingivitis; (in the middle third, the extent of alveolar resorption to great stress). Its disappearance in areas, particularly in the middle and apical third, with thickening of the dark line representing the peridental membrane, indicates an undue stress or a proliferating periodontitis. Variation of the lamina about any, and particularly, about a pulpless tooth, condemns it to exploration for normality. The roentgenogram indicates a condensing osteitis; the crypt wall containing granulomata appearing as dense as the lamina. Absence of rarefaction is not always evidence of the normal. Good roentgenograms are rarely misleading and postoperative results are more pronounced than the roentgen-ray would indicate.

In gingival, the so-called pyorrhea infections, if the traumatic factor can be corrected, even in malocclusion, 90% of the cases can always be cured, if preceding lacunar or perforating canal absorption has not undermined the tooth, provided that the dental operator will develop the fine technique of the periodontic specialist. But there can be no greater menace to a patient's health than retention of infected teeth.

In infection, there are three vital histologic factors: 1. The vitality and resistance which is offered to septic invasion by the granular layer of Tomes; 2, the recent demonstration by Noyes of a definite lymph supply in the dental pulp (the sterilization of dentin and cementum without destruction of adjacent tissues has not been accomplished as yet); all the methods, including the latest ionic medication, are much too drastic and objectionable, destroying the reparative cells but not the pathogenic element; and 3, the apical cementum and adjoining peridental membrane which has reparative power if not burned up by germicidal processes or if not too deeply infected.

Just as soon as it can be clinically and roentgenographically demonstrated that diseased periapical regions exist, medication should be stopped and surgery resorted to. All such lesions must be eradicated promptly without waiting for the patient to develop any diseases ascribed to septic teeth.

The dentist should not act as internist, nor should a physician, omitting to look for every possible focus, diagnose the focus offhand as oral. A complete diagnosis should be made, obtaining the opinions of all the specialists concerned. The mouth is sometimes overlooked in diagnosis.

If the patient will report in time, it is possible to remove the pulp and aseptically fill vital root apices of a large proportion of such teeth; but an infected or abscessed root should not be retained, unless apiectomy is attempted.

RHEIN, M. L. The Importance of a Correct Differential Diagnosis of the Predisposing Causes in Cases of Interstitial Gingivitis or Pyorrhea Alveolaris. (*J. Am. M. Assn.*, Vol. LXVIII, Feb. 10, 1917, p. 417.)

Pyorrhea alveolaris is a result of malnutrition plus infection, and also most frequently plus irritation; it is intensified if arteriosclerosis of the ultimate capillaries sets in. All forms of pyorrhea must commence with some form of gingivitis, yet the tissues in this and all succeeding stages vary in clinical appearance. Classification is necessary, as "diabetic pyorrhea," "tubercular pyorrhea," or "nephritic pyorrhea". The symptomatology and treatment should be entirely different in each type. Prognosis of pyorrhea or gingivitis must depend largely on the possibility of obtaining a cure of the malnutritional factor. The dentist treating these and all other mouth diseases should be as well educated in general medicine as the specialist in any other department of medicine.

BILLINGS, FRANK. The Principles Involved in Focal Infection as Related to Systemic Disease. (*J. Am. M. Assn.*, Vol. LXVII, Sept. 16, 1916, p. 847.)

In infection there are three chief factors: (1) The pathogenic microörganisms and the conditions which modify their virulence and pathogenicity. (2) The host and the conditions which modify his susceptibility to infection. (3) The nature and result of the reactions.

The tissues involved in the focal infections, especially those due to the streptococcus-pneumococcus group, act as a culture medium in which variations of the microörganism are brought about by variations in the blood supply, or other factors which may alter the character of the confined infectious agents.

The local infection may be coincident with general systemic infection or general infection may occur at some indefinite time subsequent to the local tissue invasion. Systemic invasion may be by way of the blood or lymph stream.

The tissues of the host are disturbed by the reactions (abscess, necrosis, hemorrhage, and gangrene) and by virulent microörganisms. Virulent streptococci and gonococci will cause purulent destructive arthritis. Less virulent streptococci and gonococci will usually result in a chronic serous or fibrinous arthritis. Pathogenic bacteria of relatively low virulence excite reactions leading to chronic confined general infection.

BLACK, ARTHUR D. Roentgenographic and Microscopic Studies of Tissues Involved in Chronic Mouth Infections. (*J. Am. M. Assn.*, Vol. LXIX, Aug. 25, 1917, p. 599.)

3300 roentgenograms were made of 400 persons, not necessarily patients, mostly selected from several sources without regard to previous inquiry as to mouth or health conditions. The results indicated the frequency of infections of the maxillary bones. The study is to be continued. The study showed that 56% of the persons under 25 years of age, 72% of those between 25 and 30, 87% of those between 30 and 40, 89% of those between 40 and 50, and 100% of those over 50 had infections involving the maxillary bones. Considering the incidence of abscesses in relation to root fillings: in 178 good root fillings in large canals, 13 were abscessed—or 8%; of 338 large canals poorly filled, 225 were abscessed—or 67%; of 242 small badly filled canals, 154 were abscessed—or 65%. This shows the need of careful technic in treatment of root canals.

The suppurative detachment of the peridental membrane is in practically all cases permanent. If such teeth are permitted to remain in the mouth, they menace the health of the individual. Their value in mastication should be weighed against the danger of nephritis, endocarditis, and other secondary results, all of which are insidious in onset, and likely to be serious before symptoms are noticed.

BYRON C. DARLING.

MILLER, WILLIAM SNOW. Stereoroentgenograms of the Injected Lung as an Aid to the Study of the Lung Architecture. (*Am. Rev. of Tuberculosis*, Journal of the National Tuberculosis Association, 1919, Vol. II, No. 11, p. 659.)

In a previous communication (*Anat. Rec.* 1918, XV, 47), the author describes the preparation of an injection mass for studying the blood vessels of the lungs. Following the injection of the mass, stereoroentgenograms were made.

The basis of the injection mass consists of

a suspension of corn-starch in 70 per cent alcohol, to which vermilion granules are added when it is desired to obtain a uniform dense shadow, and ultramarine blue granules when a less dense and finely granular shadow is desired. By the use of a greater or less quantity of 70 per cent alcohol, the injection masses may be made to penetrate to any desired distance within the lung. If the bronchi alone are to be injected a thick vermilion mass gives the best results; for if the mass be too thin it will penetrate the air sacs and a blurred shadow will result, or else the whole lung will appear solid.

The present paper deals with the study of the relation of the pulmonary artery, the pulmonary vein and the bronchi to each other in specimens of pig and dog lungs, following the injection with the above described mass, and viewed with stereoroentgenograms which accompany the article.

The purpose of the article is to emphasize the importance of knowing the normal lung architectural appearance from the standpoint of the bronchi, the pulmonary artery and vein, their relation to each other, and their distributions.

By means of these injections and stereoroentgenogram study, the author points out that the pulmonary artery follows in all its subdivisions the course and subdivisions of the bronchial tree, and that each main branch of the pulmonary artery arches over its corresponding stem bronchus and comes to occupy a position posterior and slightly lateral to the bronchus; while the pulmonary vein relations to the bronchi are quite different and are anterior and mesial to the stem bronchi, and in their ultimate distributions are as far removed from the bronchi "as possible."

Three beautiful stereoroentgenograms of these well prepared specimens are used successfully to illustrate the text. Lungs of two pigs and one dog were used.

Stereoroentgenograms of the lungs of a pig in which the pulmonary artery is injected with vermilion starch mass and then distended with air. The pulmonary artery is beautifully outlined in its entirety with the injection mass. Closely approximated to this shadow on its mesial surface are the main stem bronchi filled with air, which can be easily seen, while on the mesial side of the bronchi can be seen a faintly denser shadow of the pulmonary vein.

Stereoroentgenogram of the lungs of a pig in which the pulmonary vein of the left lobus inferior is partially injected with a thick ultramarine blue starch mass and then distended with air. The shadow of the pulmonary vein can be clearly seen situated anterior and mesial to the main stem bronchus.

Stereoroentgenogram of the lungs of a dog in which the pulmonary artery is injected with vermilion starch mass and the pulmonary vein with an ultramarine blue starch mass. The artery and vein are both shown while the bronchi are obscured by the overlying shadows of the injected artery and vein.

The author concluded that even though the pulmonary arteries are uninjected, they can be recognized in stereoroentgenograms as comparatively dense linear markings along the lateral wall of the bronchi, and under similar conditions the main venous trunk can be made out on the mesial side of the stem bronchus, but in its ultimate distribution its branches are not associated with the bronchi.

Further, that the study suggests once more the importance of a knowledge of lung structure in interpreting densities on the roentgen ray plate.

Charles A. Waters.

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LUNG ABSCESS AND BRONCHIECTASIS

A CLINICAL AND ROENTGENOLOGICAL STUDY OF ONE HUNDRED CASES

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We are yet in the dark as to the essential conditions which determine suppuration and gangrene of the lung. The various suppositions which invoke a predisposing cause in the lung of the patient are unsatisfactory. More likely it is some special quality of virulence inhering in the infecting micro-organisms which give rise to a persisting type of lung inflammation which on the one hand may usher in a rapid abscess formation with necrosis, and on the other lead to a slow induration of the lung with the gradual formation of multiple bronchiectatic cavities. The frequent occurrence of putrefaction in these cases makes it very probable that the anaerobic organisms which gain entrance to the lung by the aspiration of foreign bodies or infectious material from the mouth during operations or in states of inanition, provide the determining element in many cases.

Although we are thus poorly informed as to the etiology of lung suppuration we are somewhat compensated for this deficiency by its more complete pictorial representation (if I may use the term) afforded by consecutive roentgen examination.

Let us study the sequence of events in a case of postoperative lung abscess. In my experience this most commonly follows tonsillectomy, and only when the patient is fully under the influence of ether. There can be little doubt that these abscesses result with such relative frequency from the aspiration of the infected plugs in the tonsillar crypts which are squeezed out when the tonsil is grasped in the forceps.

The lodgment of such a plug in a bronchus gives rise to a pneumonia varying in extent from a small patch up to a whole lobe, with the usual accompanying symptoms. At the point of lodgment of this septic plug, the anaerobic organisms set up a destructive inflammation of the bronchus with the formation of a gangrenous bronchiectatic cavity of varying size. It may be small and single, or large and multiple, so that it is readily visible with the roentgen ray. Such a cavity usually lies embedded in the infiltrated lung, and by its presence and the putrid secretions which it engenders maintains a chronic irritation of the lung about it. This in a short time results in an indurative pneumonia which is no longer capable of spontaneous resolution. Such a case is illustrated in Fig. 1. Three months before,

FIG. 1.

this patient had his tonsils removed. After the usual symptoms there has developed a persistent infiltration surrounding a

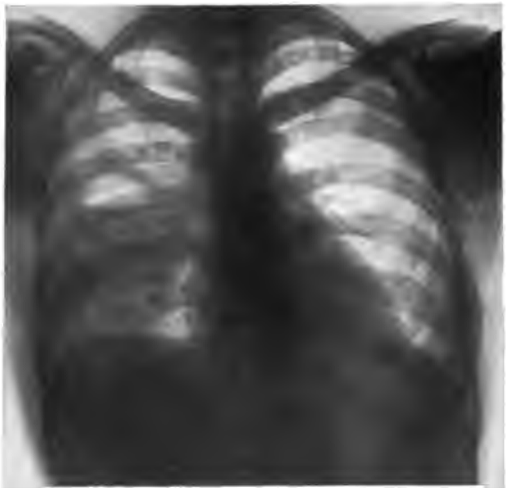

FIG. 2.

cavity in the right lower lobe. On the other hand in another case after the passage of a few weeks only, a much larger cavity has resulted. (Fig. 2.)

Let us follow the further course of such abscesses, for the present confining ourselves to the postoperative variety because they come to our attention earliest and at a time when they may undergo rapid changes. They either go on to a complete cure in a considerable percentage of the cases, or they improve to a certain extent and then suffer repeated relapses. Observe Fig. 3. Within one month a large cavity 1½ inches in diameter has

FIG. 3.

developed within a pneumonic area of moderate extent. Within another month both the cavity and the pneumonia have disappeared and only a few strands of fibrous tissue remain as a relic of the inflammatory process (Fig. 3a). It is remarkable that a cavity of this size can

FIG. 3a.

so completely disappear in so short a time, but such rapid restitution to the normal is characteristic of the healing of lung defects when the infection has subsided. If the necrotic walls of the cavity slough out and are expectorated, the anaerobic infection dies out. It no longer exerts its irritant effects on the lung; the pneumonitis subsides, the lung once more becomes air-containing, and as it expands automatically obliterates the cavity. A similar outcome occurred in the case illustrated in Fig. 4. This is the same case as Fig. 16; there is a complete disappearance of the

FIG. 4.

cavities and the infiltration is undergoing a rapid absorption. Apparently a large pneumonic infiltration can regress as readily as a small one, the only prerequisite being the sloughing out of the gangrenous area.

Unfortunately such a desired result occurs only in cases of short standing. A persisting irritation soon leads to fibrosis, which brings in its train rigid membranous cavity walls that will not collapse. Fig. 5 illustrates a case whose inception dates back eight months. The abscess has been well walled off by a definite membrane and its effects are no longer, at least for the present, propagated into the lung. Hence there is no pneumonic infiltration. But this putrid cavity, communicating with a bronchus, exists as a menace to the rest

FIG. 5.

of the lung whose integrity it constantly threatens. Such an abscess cavity is no longer capable of spontaneous healing. Sooner or later, the overflow from this cavity will infect neighboring or distant

FIG. 6.

healthy lung tissue and the disease will take on renewed activity.

An even more unfavorable condition for spontaneous or operative cure exists in a

case of the type shown in Fig. 6. Here not only has a cavity persisted but there is an induration and consolidation of the right upper lobe about it. The result of this is a progressive round cell infiltration, fibrosis; the terminal bronchioles are strangled and secondary bronchiectatic cavities develop. Usually these secondary cavities are much smaller and are not visible on the plate. In fact, in the great majority of the cases only one fairly large cavity is visible on the roentgen plate; on the operating table or on autopsy additional macroscopic cavities are usually found and also microscopic dilatations of the bronchi. Such cases can only be cured surgically by eradicating the whole diseased lobe, by a lobectomy, whereas the cases of solitary abscess without infiltration may be effectively treated by incision and drainage.

Fig. 7.

Fig. 8.

It will thus be seen that the roentgen ray affords a convenient and exact method of following the evolution of suppurative lung conditions. I am tempted to say that it is the only reliable method, for the following reasons. To assert that a case is cured because the clinical symptoms have abated or subsided is unsafe. A study of the history of these cases shows nothing more clearly than the frequency of remissions in the symptoms and the physical signs. In such a remission, which is favored by residence in the country, both symptoms and physical signs may be absent or they may be so slight that their importance and significance are not recognized. Under such circumstances the roentgen examination will always show evidence of disease. I will not speak of the cases in which the roentgen plate discloses one or more cavities that have eluded physical examination, which is not charged to the lack of skill of the examiner. More commonly there is found only a small area of pneumonic infiltration which has persisted after an apparent cure. Ill-defined, and inaccessible to ordinary methods of examination, such a focus of disease will flare up under ill-understood unfavorable conditions and reproduce a former extensive involvement of the lung. To illustrate, Fig. 7 is that of a patient who apparently recovered completely from an acute abscess. There was no clinical evidence of disease and the patient felt so well that she was with difficulty kept for observation. The plate, however, revealed the small area of infiltration in the right lower lobe. Observe its potentiality for harm. Within a week, the infection renewed itself and encompassed a considerable area of the

contiguous lung, and a cavity has formed. The symptoms also have all returned and the patient is acutely ill with all the symptoms of a gangrenous abscess of the lung (Fig. 8). Now, such a small pneumonic area may elude the most careful physical examination. In fact, one is struck by the paucity of the physical signs which even a large area may produce. In announcing a cure, therefore, of a lung abscess, not only must the clinical symptoms and signs have subsided, but all roentgen evidence of disease must have disappeared.

Experiences such as that just recounted, make it probable that the frequent exacerbations which mark the course of many lung abscesses owe their origin to an extension of existing foci of disease. Conditions for their occurrence are most favorable when there exists a large cavity full of secretion communicating with a bronchus. The spilling over of the contents of this cavity or their expulsion in the act of coughing will inundate a near or remote portion of the bronchial tree and thus at a stroke inaugurate a widespread disease. Thus in Fig. 9 it is very evident that the pus from the large cavity in the upper lobe has infected the lower lobe on the same side and has produced an extensive pneumonia. Again, such a cavity may secrete highly toxic material which, spread broadcast throughout the lung, leads to a disseminated broncho-pneumonia and a rapidly fatal putrid intoxication.

FIG. 9.

FIG. 12.

A second large group of suppurative lung conditions is that which follows pneumonia or influenza, or is a sequel of an attack of bronchitis. In a general way it is possible to distinguish two types of abscess conditions in these cases. In the one the sequence of events after pneumonia is very similar to that encountered in aspiration abscesses. Because of the early onset of gangrene with cavity formation these patients come under observation at an early date, usually during the first few weeks of their illness, and I have thus been able to determine that they differ in no wise from the previous group. In a second, larger group of cases resulting from pneumonia the patients are usually seen some months after the onset of their illness. They do not appear to become gangrenous until later and therefore many of them do not exhibit a large cavity. These cases are very insidious and go on to a progressive fibrosis with the development of numerous bronchiectatic cavities. These are the cases which commonly originate in a so-called attack of grippe, in which the transition from an acute

respiratory .infection to a chronic lung abscess is almost unnoticed. The roentgen observation of such cases is very instructive, because the persistence of fever and cough and the invariable hemoptosis lead to a strong suspicion of tuberculosis or of an encapsulated pleural effusion. On the roentgen plate one may follow the persisting pneumonic infiltration from its early stages for a period of months, noting a gradual increase in its density due to fibrosis. Here cavities are rarely visible, as they are small dilatations of the bronchi which are indistinguishable in the general infiltration. Roentgen pictures such as Fig. 12 afford evidence of an exquisite lobar distribution which at autopsy revealed a

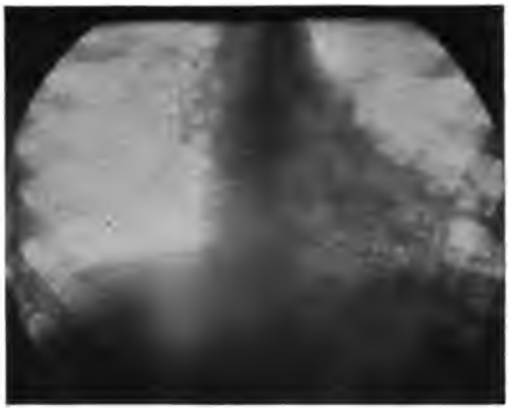

FIG. 13.

general bronchial dilatation. If the bronchi become sufficiently dilated and thin walled the roentgen plate may reveal a honeycombed appearance of the lung (Fig. 13). These cases usually have the most profuse expectoration, the secretion literally pouring out on change of position; they are often secondary to bronchitis or broncho-pneumonia contracted in childhood and may be of many years' standing. The element of putrefaction may be quite absent and the integrity of the bronchial wall maintained, so that no large cavity may result. Apparently this condition is compatible with many years of life, as the patients are not menaced by the dangers of a gangrenous process in the lungs. On the other hand, as in the previous group, there may develop single or multiple abscess cavities (Fig. 13a). The cases just described are conveniently grouped as chronic non-tuberculous lung infections in contradistinction to cases of tuberculosis which they superficially resemble. Although they are thus frequently diagnosed and are conse-

FIG. 13a.

quently found in sanatoria, it is an easy matter, by means of their characteristic roentgen appearance, to assign them to their proper place.

I wish now to present a résumé and analysis of 100 cases of suppurative lung disease and some observations suggested by a study of them.

Etiologically they may be classified as follows:

Postoperative	
a—Posttonsillectomy	21
b—Other operations	5
Postpneumonic	37
Insidious (colds, grippe)	21
Postempyema	3
Aspiration	
a—Immersion	2
b—Coma (drug and alcoholic)	2
Postnasal	1
Tuberculous	2

Postesophagus (carcinoma)	1
Actinomycotic	1
Diabetic	1
Syphilitic	1
Foreign body	2

The cases varied in duration at the time of roentgen examination from a few weeks up to seven years. The postoperative abscesses and those due to aspiration were as a rule encountered during their acute stage in the early weeks. This was also true of 16 of the postpneumonic abscesses. The remainder came under observation on an average of some months after the onset. This fact has an important bearing on prognosis, which will be explained shortly.

The relation of fetid sputum to these suppurative conditions is a matter of some interest. In the postoperative and aspiration cases the gangrene appears to be a primary and essential part of the whole disease. It is a remarkable fact, elicited by careful history taking, that irrespective of the time of onset of pulmonary symptoms evidences of gangrene invariably present themselves on the 13th or 14th day after the operation. This does not necessarily consist in the expectoration of foul sputum; occasionally the patient experiences only a foul odor to the breath or a similar taste in the mouth. This uniform onset of the fetor on the 13th or 14th day is perhaps related to the biology of the anaerobic bacteria responsible for it. The gangrenous inflammation appears also to be intimately associated with the progress of the disease. Usually an aggravation of the symptoms is associated with an increase of the fetor and the sloughing out and expectoration of the necrotic lung may be followed by temporary or permanent improvement. The gangrene also seems to be related to the formation of the larger, easily demonstrable cavities. With respect to the gangrene, the postpneumonic cases appear to fall into two groups. Sixteen of the cases here reported developed an acute abscess following pneumonia. As in the postoperative cases the gangrene invariably began on the 13th–14th day. For this reason it seems to me very likely that the mechanism of lung abscess formation in these cases is similar to that in the operative cases. I think it may reasonably be questioned whether these are not really primary cases of lung abscess, which have resulted from the aspiration of infected material from the mouth, perhaps during sleep. The analogy between these cases and those of lung abscess which develop after coma is so close as to be significant, and it is suggested that at least this one group of so-called postpneumonic abscesses may find its remote origin in diseased tonsils or gums. In the remaining postpneumonic cases the gangrenous process is apparently of minor importance. It is only engrafted after some months on a previous pneumonia which is probably from its inception of a chronic indurative nature. In many of these cases no large cavities are found, and if fetid sputum occurs it does so intermittently, and does not seem to affect the course of the disease unfavorably. Conversely, in all the postpneumonic cases in which a large cavity was visible on the plate, the patients had fetid expectoration.

CAVITIES

The relation between the larger cavities which are demonstrable by roentgen rays to the origin of the disease may be shown as follows:

Aspiration abscess	cavity	21	(37)
	no cavity	3	
Non-aspiration abscess	cavity	29	(13)
	no cavity	30	

If from the 29 cases of non-aspiration abscess which showed a cavity there are deducted the 16 cases of acute pneumonic abscess, which there is reason to believe are also due to aspiration, the corrected figures will appear as in the parentheses above.

It will be seen that the large cavities result more frequently from the acute aspiration abscesses, and this is probably

due to the larger rôle which the gangrene plays in the former. Its importance in causing a rapid breaking down when it is engrafted on a previously diseased lung is well shown in Fig. 14. The history of this patient makes it evident that he was the subject of a chronic pneumonic process of about two years' standing. His expectoration, although profuse, was never gangrenous. After an operation for appendicitis under general anesthesia there is a marked progress of the disease with the formation of a large cavity and putrid expectoration.

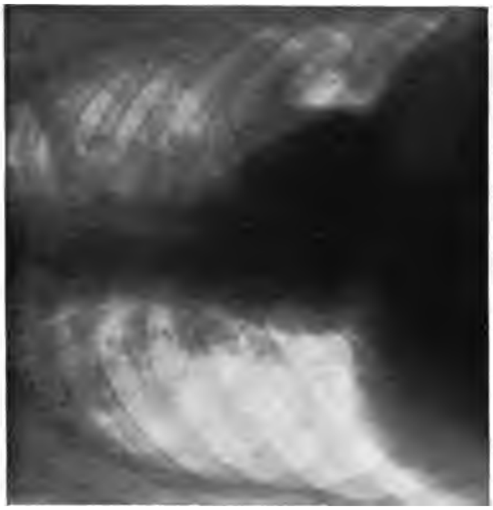

FIG. 14.

PHYSICAL SIGNS OF CAVITY

In only a small percentage of cases were there undoubted physical signs of cavity. In this regard the superior value of the roentgen ray is striking, as it disclosed a cavity in forty-five cases. The value of such a determination and localization in the surgical treatment is, of course, evident if the question of drainage of such an abscess cavity arises. Most cavities are circular in shape and usually do not evidence any definite abscess membrane. They appear rather as a circular or semilunar defect in the infiltrated lung, and in the majority of cases are bisected by a horizontal or slightly concave fluid level. This level is so sharp and is so pathognomonic of a cavity, that its occurrence may be taken as evidence of an abscess cavity even though its superior wall is not seen, as may occur if the infiltration is not very dense. In a doubtful case an exposure in the lateral

FIG. 16.

recumbent position will demonstrate a shift in the fluid level. Such a manœuver will sometimes disclose a cavity not otherwise visible. Thus in Fig. 14 a lateral recumbent examination exposed the fluid level of a cavity which in the upright posi-

FIG. 17.

tion was obscured by the heart shadow. The multiple diffuse dilatations of the bronchi are visible only in the exceptional case in which the thin walled bronchi are enlarged and spherical and their lumen is not obscured by infiltrated lung (Fig. 13).

The existence of a cavity cannot safely be denied from a single examination, as its demonstration may depend on varying physical conditions. If a cavity is full of secretion, or if it is small and imbedded in the consolidated lung, it may become visible only after it is partly emptied by expectoration, or after a removal of the pneumonic process. Figs. 16 and 17 illustrate such a case. After the expectoration of eight ounces of pus, three small cavities, previously invisible, can now be distinctly seen. In Figs. 18, 19 and 20, there is noted the appearance of a cavity after expectoration, and of several more which came to light after operative removal of some of the overlying indurated lung. Again, in Fig. 21, an oblique view shows an irregular

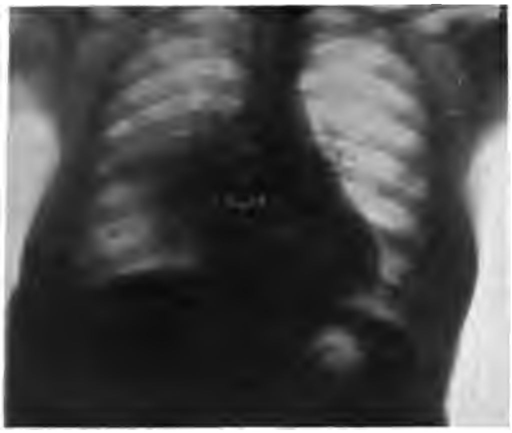

FIG. 18.

FIG. 20.

FIG. 19.

FIG. 21.

cavity in the middle lobe which was not seen in the dorso-ventral position.

LOCATION OF ABSCESS

Suppuration may involve any one or more of the lobes of the lung. Not uncommonly two lobes are affected. This is especially true of upper lobe abscesses, which are frequently a source of infection of the lower lobe.

There is a distinct difference in the localization of abscesses following aspiration and those following pneumonia, as will be seen from the following table:

	Upper lobe	Lower lobe	Middle lobe
Aspiration abscesses......	18	9	1
Non-aspiration abscesses.	24	44	3

A similar analysis of those cases of acute postpneumonic abscess, which I have reason to believe are also aspirative in origin, shows the following:

	Upper lobe	Lower lobe	Middle lobe
Acute postpneumonic abscesses...............	8	7	1

It will be seen that upper lobe suppuration in aspiration abscesses is twice as common as involvement of the lower lobe. In the remaining cases the conditions are just reversed. Isolated abscess of the middle lobe occurred twice, in one case after tonsillectomy, and once in a syphilitic patient.

One of the more striking symptoms of lung abscess is hemorrhage, as it occurs in almost every case in some stage of the disease. In fact, it is a more constant sign than is hemorrhage in pulmonary tuberculosis. Although it is usually moderate in amount, it is occasionally profuse and in several cases was fatal.

Clubbing of the fingers was present in 12 cases. Its earliest appearance was noted at six weeks after the onset; it usually developed, however, after a few months.

COMPLICATIONS

The complications of lung suppuration present several points of interest. As they occurred in this group of cases they were as follows:

1. Rupture of a bronchiectatic cavity with pyopneumothorax;
2. Empyema;
3. Fatal hemorrhage;
4. Septic embolism of the brain;
5. Arterio-venous aneurysm of the lung;
6. Putrid pneumonia and intoxication.

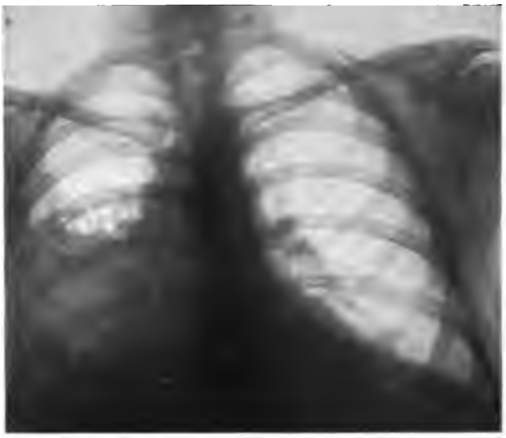

FIG. 22.

Plates 22 and 23 illustrate the sequence of events following rupture of a bronchiectatic cavity. The patient, an elderly woman, had had a cough for nine years and had apparently a widespread bronchiectatic condition of the right lung. A sudden exacerbation of her symptoms

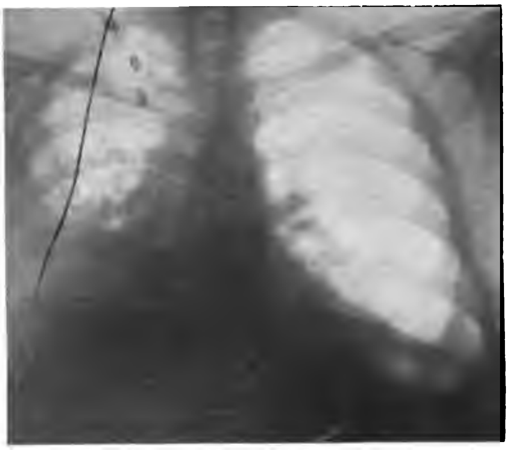

FIG. 23.

is associated with the appearance shown in Fig. 23. The pleural cavity is half full of fluid whose level is horizontal, indicating the co-existence of air and fluid in the chest, which was corroborated on operation. Such a result may be expected when the rupture occurs into the free pleural cavity. Probably more frequently this is preceded by the formation of pleural adhesions, so that on subsequent rupture there develops a localized empyema, which usually communicates with a bronchus. Such a local effusion may thus mask an underlying lung abscess, and only the persistence of a bronchial fistula will lead to the suspicion of a pre-existing lung disease. This is particularly apt to take place in the case of aspiration of foreign bodies, in which, owing to the extreme youth of the patient, a history of such aspiration is not obtainable, and the first evidence of serious disease is the occurrence of an empyema. Foreign bodies are so unexpectedly discovered as a cause for abscess conditions of the lung that no examination can be considered complete until a roentgen examination and bronchoscopy have been

FIG. 24.

performed in order to determine their presence.

Fig. 24 illustrates an unusual sequel of a lung abscess. Eight weeks previous to the examination the patient had a typical postpneumonic abscess with fever, fetid sputum and early clubbing of the fingers. At the time of the examination he was almost well. He was repeatedly examined by the roentgen ray for about a year, and the shadow noted in the plate above remained constantly the same. He then died of cerebral abscess. Autopsy revealed an arterio-venous aneurysm of about the

FIG. 25.

size of a hazel nut surrounded by a thin connective tissue capsule.

CURE OF CASES OF LUNG SUPPURATION

In this series of 100 cases, only eleven recovered spontaneously. It may be of some interest to analyze these cases, to determine, if possible, the conditions which favored recovery. Of the eleven cured cases, nine were postoperative abscesses, eight of which followed tonsillectomy. Only two of the cases were postpneumonic. It may even be questioned whether one of these cases completely recovered, as he died of a metastatic brain abscess. It will thus be seen that over one third of the postoperative abscesses recover spontaneously. There appears, however, to be a definite time beyond which such spontaneous healing does not occur. In all the cases healing was complete three months after the onset, and it was probably determined

some weeks earlier. Every one of these cases gave evidence on the roentgen plate of a fair sized cavity. It is evident that no operation should be attempted in these cases until after the lapse of three months. The postpneumonic cases apparently have a bad prognosis, as they lead to a diffuse indurative pneumonia which favors the formation of multiple bronchiectases. Even the acute postpneumonic abscesses, which in other respects appear to resemble the aspiration abscesses, do not appear to get well of themselves. Only two of these cases recovered, although it is possible that several others which passed out of observation also got well. In the post-pneumonic abscess of months' and years' standing there is apparently no prospect of recovery by medical measures.

The single case of syphilitic lung abscess recovered completely under specific treatment. This case began to cough rather suddenly and in a short time presented the

FIG. 26.

typical symptoms of lung abscess of the middle lobe (Fig. 25). A vigorous course of salvarsan resulted in a rapid cure and a disappearance of the infiltration (Fig. 26). In a case of abscess of the middle lobe of doubtful causation a course of anti-luetic treatment would be advisable.

Of the cured cases, in two, an artificial pneumothorax was attempted. Although the roentgen plate showed that in neither

FIG. 27.

was there an effective pneumothorax or a collapse of the lung, prompt improvement ensued on the operation. It is evident that the cure cannot be ascribed to the pneumothorax in these cases, nor does the latter promise to be of any value.

Five cases were cured by operation which consisted in an extirpation of one or more diseased lobes. The operations, performed by Dr. Lilienthal, were undertaken

FIG. 28.

only in cases of some months' standing, that is, after the lapse of the period during which spontaneous healing might result.

A cure of these patients by operative means cannot be effected by incision and drainage of one or more abscess cavities. It is necessary to excise all or the greater portion of

FIG. 29.

the diseased lung. All the interesting details of the operation as developed by Dr. Lilienthal and the postoperative problems cannot be gone into. It is sufficient to say that the roentgen plate reproduces with unexampled faithfulness the results of the various operative procedures and is helpful in gauging their success. Figs. 27 and 28 show an abscess before operation and the appearance of the chest after lobectomy and a plastic operation to collapse it. Fig. 29 represents a foreign body bronchiectatic lung which was completely removed by operation. It is interesting to observe how the remaining portion of the lung expands to fill up the dead space so that a few months later there is no evidence of the previous trouble either in the conformation of the chest or in the appearance of the lung (Fig. 30).

In conclusion, a few additional remarks on the rôle of the roentgen ray in the diagnosis of these conditions may not be amiss. It may be stated at once that in the great majority of the cases, a diagnosis of lung abscess or bronchiectasis can be made from the clinical history alone, without any further examination. The expectoration of purulent or fetid sputum is a symptom so characteristic as to be unequivocal. Little is achieved, however, by the mere diagnosis. In order to arrive at an exact localization, to determine the presence and the location and the size of the cavities or the existence of infiltrations, one must have recourse to physical examination. It is, however, surprising how few physical signs even an extensive infiltration will produce. The most constant signs were dullness, often slight, and diminished breathing over a circumscribed region of the lung. As far as cavities were concerned, in only twelve cases were there indubitable physical signs of a cavity. In the cases with a small residual infiltration, physical signs were usually absent, especially when the disease affected the hilum of the lung. This uncertainty in the results of physical examination is in strik-

FIG. 30.

ing contrast to the clear cut data furnished by the roentgen plate.

Further there are cases in which neither the clinical history nor the physical examination furnish grounds for the diagno-

sis of lung abscess,—cases of chronic bronchitis, of tuberculosis or of aneurysm of the aorta, to mention but a few. In such conditions the diagnosis may remain at a standstill until the roentgen ray unearths an area of chronic pneumonia with bronchiectases as a basis for the persisting symptoms.

Although in a majority of the cases the roentgen appearance of suppurative lung disease is characteristic, it will occasionally be difficult to distinguish it from other diseases of the lung, such as tuberculosis, localized empyema, or new growth. In such cases the clinical data, if intelligently utilized, will usually make a diagnosis possible. In no other branch of his work can the roentgenologist bring his clinical and pathological knowledge to bear with greater advantage. But he must be given the same opportunity as the clinician to reëxamine the patient if he is in doubt, in order that he may retrieve an initial error and revise his diagnosis. The value of such reëxaminations is shown in the following case. A much emaciated patient presented the clinical signs of a consolidation of the left upper lobe, and a probable diagnosis of carcinoma of the lung was made (Fig. 31). Subsequent examinations showed this diagnosis to be unfounded. The supposedly solid growth gradually receded from the apex and in its stead there remained a large abscess cavity partly filled with fluid, the rest of which had been evacuated by the patient (Fig. 32).

FIG. 31.

FIG. 32.

THE RADIATOR TYPE OF TUBE

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THE radiator type of tube has already been described.[1] Up to the present time, its use has been confined exclusively to the army and in this service it has been used as a self-rectifying tube in the Portable and Bedside outfits. Owing to the fact that the tube has recently become generally available for use on existing standard generating outfits, the following amplification of what has been published will perhaps be useful.

The leading motive in the development of this type was originally to get, in the form of a small simple and rugged structure, a tube which would operate satisfactorily when alternating current was supplied to its terminals. As will be seen from the following, however, the use of the tube should not be limited to such service,[2] for it will do better diagnostic work on any generating outfit than will the earlier form of hot-cathode tube with the solid tungsten target.

FIELD OF USEFULNESS OF THE RADIATOR TUBE

This type of tube makes possible the use of a simple transformer[3] as a current generating outfit (for direct current circuits a converter must be added). It has been found that a little transformer of suitable design and weighing but slightly over 50 pounds is adequate for supplying a current of 50 milliamperes at a useful gap of 5″ to a self-rectifying tube. This, of course, means that a very small and relatively inexpensive outfit of this type can be made to do even very rapid diagnostic work. The freedom from mechanical and electrical complications and from noise and the diminution in the odors attendant upon high tension discharges in air seem very much in favor of this system.

The tube operates satisfactorily on the transformer, the interrupterless outfit, and the induction coil, and is hence generally applicable to diagnostic work. With the induction coil it renders a valve tube unnecessary. With the interrupterless machine, it offers the advantage that it is not injured by a faulty setting of the mechanical rectifier. With every current source it permits of the intermittent use of more energy than could in practice safely be carried by a tube with a solid tungsten target and the same size of focal spot.

It is not, in its present form, adapted to therapeutic work, for, with continuous operation, it will carry less than one-fourth as much energy as the 7-inch hot-cathode tube with solid tungsten target.

CURRENT-CARRYING CAPACITY OF THE RADIATOR TUBE

For a given voltage, the current-carrying capacity of the radiator type of tube is a very definite quantity. This is due to the fact that the target of the radiator tube cools so rapidly, between exposures, that every exposure is started with a relatively cold target. What can be done with the tube then, in radiographic work, depends but little on its past history.

This will perhaps be made clearer by the following consideration: The target, with its heat-storage capacity, is like a reservoir used for the storage of water. It is capable of absorbing and storing up an amount

[1] *Gen. Elec. Rev.*, 21, pp. 55–60 (1918).

[2] It is, perhaps, necessary to place additional emphasis on this point for the reason that one is instructed in the U. S. Army *X*-ray Manual not to use this tube on large installations or interrupterless machines. This was doubtless, under the circumstances existing at the time, a wise regulation. To apply this regulation to civil practice, however, would be equivalent to saying that no 10 ma. *x*-ray tube should be operated from a large machine.

[3] This word, transformer, is so generally incorrectly used by the roentgenologist that a definition will not be out of place. A transformer is a device for transforming an alternating current of one voltage to that of another. In its simplest form, it consists of two coils of wire placed around a common iron core. It is *not* an "Interrupterless Machine"—the latter consists essentially of a transformer, a synchronous motor, and a mechanical rectifying switch.

of heat energy, which is determined by the size of the target and by the amount of heat already in it, just as the reservoir is capable of taking up an amount of water determined by its size and by the amount of water already in it. The capacity of the target to take up heat is always the same provided it is always at the same temperature at the beginning of the exposure.

It is then a simple matter for the manufacturer to specify the capacity of tubes of the radiator type.[4]

In the particular service for which the radiator tube was first developed, the amount of electrical energy available at the tube terminals was strictly limited and corresponded to 10 ma. at a 5-inch useful gap. The focal spot in the first model was then made as small as could be conservatively used with this amount of energy (1/8-inch in diameter). In this connection, the writer wishes to lay emphasis on the word *conservatively*. He has seen one of these tubes which had been in almost constant radiographic service in a base hospital for a period of several months. It had been operated on an interrupterless machine with a load of 10 ma. at a 5-inch gap. Inspection showed that the focal-spot had never even been frosted and could not be identified without operating the tube. Under such circumstances and with such consistent use, there is, of course, a temptation on the part of the operator to increase the load and to exceed the current specified by the manufacturer. The writer, however, cannot see a justification for doing this. If, without serious damage, a current of say 30 milliamperes could occasionally be used with a tube marked 10 ma., it might seem worth while; but it can't be done. It will ruin the tube. With the tube, in the base hospital in question, the current could undoubtedly have been raised 50 per cent and this would have reduced the time of exposure to two-thirds of what it had been. The point which the writer wishes to make, however, is that the gain derived from attempting to operate a radiator tube, or any other roentgen ray tube of any kind, or a jack-knife, or any other device, at the breakdown point is out of all proportion to the cost.

Later in the war it was felt by some that there was need, in the army service, of a limited number of mobile outfits having a higher current capacity than the standard U. S. Army Portable outfit. For this reason, experimental work was undertaken on a larger size, 3 K.W., Delco-light set. It developed that, with certain minor changes, this set, when connected to the small x-ray transformer used in the standard Portable outfit, was capable of delivering 30 ma. at a 5-inch useful gap to a self-rectifying tube.

It was found that a radiator type of tube with a 3/16-inch focal spot behaved nicely with the 30 milliampere load. Except for the larger focal spot, this tube was identical with the 10 milliampere radiator tube.

There is every reason to think that, with a still larger focal spot, this same design of radiator tube will be found equally satisfactory for 100 milliamperes or more, and that it will still operate just as well on alternating as on rectified current.

The current-carrying capacity is the same for alternating as it is for rectified current, as the tube will safely rectify any current which does not damage the focal spot.

OPERATION ON TRANSFORMER (WITHOUT MECHANICAL OR OTHER RECTIFIER)

When used where it has to rectify its own current, the radiator type of tube shows its greatest superiority over the hot cathode tube with the solid tungsten target,[5] used under the same conditions.

[4] In the case of the earlier type of tube with the solid tungsten target, the specification of current-carrying capacity was always rather unsatisfactory for the reason that the cooling of the target in this tube, between exposures, was relatively very slow. Because of this latter fact, the target temperature, at the beginning of an exposure might be anything between room temperature and intense white heat. The amount of heat which the solid tungsten target was capable of storing up and, hence, the current-carrying capacity, was then a very variable quantity, depending on the temperature of the target at the beginning of the exposure.

[5] The latter should never be used to rectify its own current. The reasons will be obvious from the following data.

This is illustrated by the following experimental data:

30 Milliampere Radiator Tube, Operated from Transformer (without Rectifier)

With the target at room temperature, a current of 30 milliamperes at a 5-inch useful gap was applied continuously for 35 seconds. At the end of this time, there was a slight flash of green fluorescence in the tube and evidence of a slight high voltage surge on the line. The target was bright red. No harm had been done to the tube, but it would have been unsafe to continue without interruption.

With intermittent operation, it was found that a 6-second exposure with 30 milliamperes at a 5-inch useful gap could be repeated indefinitely with 40 second intervals between exposures.

With suitable intervals between, exposures with 30 ma. ranging in time from 0 to 35 seconds could then be made.

Medium Focus 7-Inch Tube with Solid Tungsten Target, Operated from Transformer (without Rectifier).

Starting with the target at room temperature, this tube was operated with 30 milliamperes at a 5-inch useful gap for 10 seconds. At the end of this time it showed green fluorescence at the cathode end, indicating that it was beginning to pass inverse current. The target was red hot. Experience has shown that had the operation of this tube been continued further without interruption, it would have been put permanently out of commission, either from cracking the bulb back of the cathode or from deterioration of vacuum.

After waiting 15 minutes for the target to cool, it was found that the tube would carry the 30 ma. load for 5½ seconds, at the end of which time, inverse again appeared. After a further wait of 21 minutes, it was possible to operate it for 7 seconds.

This tube then would have stood, from a cold start, a single 30 ma. exposure of 10 seconds, and repeated exposures of 6 seconds duration with intervals of about 20 minutes between.

Broad-Focus 7-Inch Tube with Solid Tungsten Target, Operated from Transformer (Without Rectifier).

Experiment showed that this tube could be run with 30 milliamperes at a 5-inch gap for 6-second exposures at intervals of 15 minutes.

Further Considerations

With the present design, the 7-inch tubes with solid tungsten target show considerable differences in the evenness of distribution of energy over the focal spot. The two 7-inch tubes tested were taken at random and for this reason they do not represent the worst conditions. Other tubes will be found which will behave even worse than these when operating on alternating current.

It is also a fact that commercial experience with this type of tube operators directly from a transformer (without a rectifying device) has resulted in the rapid destruction of tubes and has been thoroughly unsatisfactory.

The 30 milliampere radiator tube was designed to rectify its own current. It was, in the above mentioned experiments, always much further from the actual breakdown point than were the other tubes. A load much higher than that used would have been necessary to produce inverse with the radiator tube (the fluorescence referred to in the test was due to gas given off from the hot copper and was not a manifestation of inverse current), and, had inverse been produced, it would have been intercepted by the hemispherical cathode and so kept from hitting the glass.

The above tests can then be summarized as follows: Running directly from a transformer (without a mechanical rectifying switch), the 30 milliampere radiator tube was operated for single periods of 35 seconds duration, while the limiting time of operation with the medium focus solid tungsten target tube was 10 seconds.

Six-second periods of operation could be repeated indefinitely with 40-second intervals with the radiator tube, while intervals of 15 and 20 minutes were needed with the other two tubes. Furthermore, the radiator tube was not endangered by the above tests, while the others were being operated very close to the breakdown point.

Attention should be called to the fact that the above tests were forced tests. They are given merely to show the radically different behavior of the two types of tube when operating on alternating current. At the present time, there is certainly no occasion in diagnostic work to use 30 ma. at a 5-inch useful gap for a period of anything like 35 seconds or to make any considerable number of consecutive 6-second exposures with a time interval of only 40 seconds between them.

OPERATION ON INTERRUPTERLESS MACHINE

For satisfactory diagnostic work, it is imperative that a voltage control of the auto-transformer type rather than the resistance type be employed. The use of auto-transformer control will ensure constant voltage and will hence greatly facilitate the duplication of results.

The results obtained should be better than with the tube having a solid tungsten target; for in general, for a given amount of energy, a smaller focal spot can be used in the radiator tube.

The tube also offers this additional advantage, for use on the above outfit, that a faulty setting of the rectifying device, resulting perhaps in sufficient inverse to ruin the tube with the solid tungsten target, will not injure the radiator tube.

OPERATION ON INDUCTION COIL

The radiator tube is well adapted to induction coil use and renders a valve tube unnecessary. The cathode filament may be supplied with current from an insulated storage battery or from a small converter and special step-down transformer. For diagnostic work, however, the induction coil outfit, because of its complications, does not seem competitive with the simple transformer.

USE OF LOW MILLIAMPERAGE

Some enthusiastic users of a 10 ma. tube seem to feel that there is some mysterious advantage derived from the use of low milliamperage per se. In some cases they have gone so far as to take tubes adapted to operation with say 40 ma. and run them at 10 ma.

There is no harm in doing this; but it is easy to show by actual experiment that, provided the same voltage and the same exposure time, reckoned in milliampere seconds, are used, radiographs made with a 40 ma. tube at 10 ma. cannot be distinguished from those made at 40 ma.

It is true that, unless the operator is equipped with a time switch adapted to the measurement of short time intervals, he will time his exposures more accurately when using low milliamperage and longer intervals.

The main advantage, however, to be derived from the use of low milliamperage comes from the fact that it makes possible the use of a tube with a small focal spot. It is easy to demonstrate that, with satisfactory immobilization of the subject, and the same focal-spot-plate distance, the same voltage and the same exposure in milliampere-seconds, the definition is always better the smaller the focal spot.

SHIELD FOR THE RADIATOR TUBE

The main advantage of the split glass shield which has been developed for the radiator tube, consists in the fact that it completely surrounds the tube and is made of thick glass having a high lead content.

In case the focal spot happens to be exactly in the plane of separation of the two halves of this shield, there is seen to be a very thin beam of roentgen rays escaping through the joint. This leakage is so slight,

however, that it would seem to be unimportant. It can, moreover, be completely stopped by seeing that the focal spot is not in the plane of separation. One of the advantages of the present design lies in the fact that it makes possible the condition that each half shield shall fit together with every other half shield to make a pair.

The method of supporting the tube in the shield has come in for deserved criticism. An experimental model has been made in which the outer ends of the glass are threaded to take hard-rubber screw caps. These caps force tapered split bushings of some resilient material, such as cork, in between the arms of the *x*-ray tube and the shield. This holds the tube securely in position in the shield and prevents rotation.

EFFECT OF THE RADIATOR TUBE ON THE DESIGN OF GENERATING APPARATUS

While it is early to make many predictions concerning the new generating apparatus which will be developed for operating this tube, the following statements seem to the writer to be conservative.

Much fluoroscopic work and much radiographic work will be done with a simple transformer outfit operated from a lamp socket. Such small outfits will be very simple and can be made almost fool-proof.

There is a splendid field of usefulness for a small light-weight hand-portable outfit operating on this system, to use in the home of the patient who cannot be moved to a roentgen ray laboratory. Preliminary experiments seem to indicate that a suitable small transformer weighing not more than 40 or 50 pounds can be made for this service.

In the field of dental radiography, it seems certain that the outfits of this type which have already been developed by different manufacturers will find a wide field of usefulness.

CONSTRUCTION OF THE TUBE

The forced large-scale production of the tube, incident to its war use and certain war-time conditions, brought about several radical changes in tube construction.

The fact that an insufficient number of skilled glass-blowers was available made it necessary to develop special machines with which most of the glass-working could be done by girl operators. Help was also obtained by getting from the glass works mold-blown parts, such as the cathode side-arm, and the anode- and cathode-support tubes, instead of making these by hand from glass tubing.

About twelve dollars worth of platinum was needed in every anode and at one time the radiator tube enjoyed the unenviable reputation of being the biggest war-time consumer of platinum that there was. Research work which had been carried on for several years finally resulted in the production of an entirely satisfactory substitute for platinum in this field, consisting of an alloy of iron and nickel covered with copper.

The early exhaust work called for one skilled operator for each tube on the pumps, to control the current supplied to the tube. Experimental work in this field, however, finally resulted in the development of a very simple exhaust system which automatically accomplishes what the best operator had done. The system consists of a small high-tension transformer connected to the tube terminals. In series with the primary of this transformer is a large ballast resistance, the function of which is to lower the amount of energy supplied to the tube as gas is liberated from the glass and the electrodes. The filament-current transformer is operated in parallel with the primary of the high-tension transformer and, as a result of this connection, and the presence of the ballast resistance, the filament temperature is automatically lowered whenever gas is liberated during the exhaust. The entire operation is carried out without adjustment of either the ballast resistance or the filament current control.

SOME ROENTGEN-RAY EVIDENCE RELATED TO THE ETIOLOGY OF CARCINOMA *

BY CHARLES L. MARTIN, E.E., M.D.

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THE cells of the human body may be likened to the inhabitants of a nation. Each one dwells with neighbors of its own class, performs definite duties and obeys certain well defined laws. So long as all of these conditions are fulfilled there are peace and harmony throughout the organization. But when some strange influence creeps in, causing certain cells to become overactive and disobey the laws and limitations to which they have been subject, there is no more peace; the organization begins to totter and a condition exists called revolution in the nation or cancer in the human organism. If it were possible to identify the powerful influence which acts as the instigator of this upheaval, much might be done to eradicate it. Many investigators have attempted this task and as the matter stands today "Chronic Irritation" seems to be the chief offender.

The clinicians have been as active as the laboratory men in searching for evidence, and since clinical findings are often of more value than animal experiments, I wish to consider some of them very briefly.

Everyone is familiar with the contention that malignant degeneration of the skin follows repeated exposure to soot, certain dyes, raw winds, powerful actinic rays, and similar influences. Many observers have held this view for a number of years.

More recently some evidence has been advanced in connection with gastric and mammary malignancy. In 1915 Dr. William MacCarty of the Mayo Clinic made a study of sections from 1373 cases of chronic cystic mastitis. He states that if it is assumed that malignancy exists when a hyperplasia of the epithelial cells has penetrated the basement membrane and invaded the surrounding stroma, 967 of his 1373 cases, that is about 70 per cent were malignant. On the basis of these findings he feels that he may assume that carcinoma is a secondary change following long continued inflammation. However, in the face of this opinion, Dr. Parker Syms of New York published a paper in 1917 in which he makes the following statement:

"If cancer of the breast does occur as the result of a progressive series of processes there have not as yet been made sufficient investigations definitely to demonstrate it as a fact."

In the years 1905 to 1907, Dr. Christopher Graham, also of the Mayo Clinic, advanced the theory that cancer of the stomach might be looked upon as a secondary degeneration occurring at the site of an old gastric ulcer. His reasons were:

(1) That although many cases of gastric malignancy have a short history, about 48 per cent of one of his series of cases gave long histories of gastric disturbance.

(2) That gastric ulcer may have a latent period with no symptoms for years.

(3) That in the year 1906 to 1907 at the St. Mary's Hospital 62 per cent of the malignant tumors of the stomach removed at operations showed a non-malignant or precancerous portion when examined microscopically.

Several workers oppose the theory advanced by Dr. Graham. The conclusions of Dr. George W. Holmes of Boston are of interest. Dr. Holmes bases his opinion on the findings in the cases examined by means of the barium meal and the roentgen rays at the Massachusetts General Hospital during the past five years. He has during that time made a diagnosis of gastric or

* Read before the Boylston Medical Society of the Harvard Medical School.

duodenal pathology in 1273 cases. To those who doubt the accuracy of roentgen-ray diagnosis in gastric conditions, I wish to quote the following figures: In the year 1914–15, Dr. Holmes made a correct diagnosis of 87.8 per cent of the duodenal ulcers, 96.7 per cent of the gastric carcinomata, and all of the gastric ulcers that came to operation. He feels that cancer of the stomach is not as a rule a secondary change occurring on top of an old gastric ulcer because:

(1) Ulcer is about twice as common in the duodenum as in the stomach while no primary malignancy in the duodenum has ever come under his observation. In his series of 1273 cases, the diagnosis of duodenal ulcer was made 594 times and that of gastric ulcer 364 times.

(2) If Dr. Graham's theory were true one would expect to find many more cases of gastric ulcer than of gastric malignancy. In Dr. Holmes' series the diagnosis of gastric carcinoma was made 315 times and that of gastric ulcer 364 times.

(3) Most cases of ulcer have a long history covering several years while the history of cancer is usually a matter of months.

(4) The ulcer case usually has suffered from pain for a long period. The cancer case suffers from pain for a relatively short period, if at all.

In summing up this very brief survey of the clinical evidence I think it is fair to say that chronic irritation has not been proven definitely to be the sole etiological factor in the production of cancer.

Let us now turn to the experimental side of the problem. The history of experimentally produced carcinoma is a very brief one since it may be said to have begun with the work of Bernard Fischer published in 1906. He used a fat soluble dye, scarlet red, as his stimulating agent and produced marked epithelial overgrowth and invasion of subepithelial tissues with epithelial cells thereby. Although these structures looked somewhat like malignant tumors histologically they probably were not, since they ceased to grow as soon as the effect of the dye was exhausted and did not produce metastases.

In 1910 three French experimenters, Marie, Clunet and Lapointe, published an account of their experiments on white rats with the roentgen ray. They stated that, following repeated exposures, their animals developed a dermatitis and that finally two rats developed growths which appeared to be spindle cell sarcomata. These growths recurred after removal by operation and were said to grow into the muscle and peritoneum, destroying these structures.

In 1914 Fibiger stated that he had produced malignant tumors in the stomachs of rats by allowing them to eat roaches which were infected with the parasite spiroptera. This parasite has a very stimulating effect on the lining epithelium of the stomach and six stomach tumors appeared in the animals to which it had been fed. Four of these tumors were said to metastasize. The editor of the *American Medical Journal* in discussing this work suggests that the malignant growths following infection of the human bladder with Bilharzia may have a similar etiology.

In the year 1915–16 two Japanese scientists, Yamigawa and Ichikawa, working at the University of Tokio, brought forward some very strong proof favoring the chronic irritation theory. Their experiments were performed upon the ears of rabbits upon which structures spontaneous carcinoma has never been observed. The inner surfaces of the ears were painted with coal tar every two or three days for periods of from 50 to 400 days. They obtained epithelial overgrowth and what appeared to be true squamous cell cancers in this way. The epithelium of the hair follicles seemed to react most vigorously and the follicles often formed retention cysts. After 30 to 60 days of repeated stimulation the hair follicle epithelium developed into minute nodules which later took on a polypoid or verrucose form. The wartlike structures in some cases formed

cutaneous horns after the stimulating applications were stopped. The ear cartilage, veins and lymphatics were found to be invaded by the tumor cells in several of the animals and two showed metastases in the lymph nodes at the bases of the ears. The tumors on the ears of these two animals grew steadily after the applications of tar were stopped and the rabbits lost weight. One of them weighed about one half its original weight at the time of death. The tumors produced by these workers, which they call folliculo-epitheliomata, seem to be the nearest approach to real experimental neoplasms that we have at present.

Last July a paper was published by Doctors Bullock and Rohdenburg of Columbia University in which they give their results following the application of mechanical and chemical stimulation to the lining epithelium of the stomachs of rats. They used celluloid balls covered with pigs' bristles, pieces of cork armed with pin points and sponges and pieces of wick soaked in scharlach R oil and pine tar oil. They obtained papillary and polypoid tumors in the squamous cell portion of the stomach which resembled cystadenomata. However, the conclusion of their article reads as follows:

"In irritation tumors a typical proliferation and invasive growth, even when extensive, are doubtful criteria upon which to base a judgment of malignancy; in the absence of continued growth after the action of the extrinsic irritant has ceased, experimental tumors should not be classed as malignant however close be the morphological resemblance.

"The fact that the lesions reported by the various observers quoted are produced as readily in young as in old animals and that apparently they do not possess the power of continuous growth upon transplantation into animals of the same species, increases the doubt regarding their malignant properties.

"All of these facts point to the conclusion already deduced from clinical observation that age, organ specificity, and congenital defects play an important, and in many cases a decisive, rôle in the determination of the origin of cancer and that irritation alone is an insufficient factor."

In all of this work it would seem that one of the most likely ways of producing malignancy has been very much neglected. I refer to the use of the roentgen rays. In 1909 Dr. C. A. Porter collected the records of 47 cases of severe roentgen-ray lesions, 36 of which he says were undoubted epidermoid cancer, while four were described as beginning epithelioma and two as questionable sarcomata. In considering this series of cases, there are three points of interest which stand out prominently:

(1) The greater number of malignant tumors appeared in persons ranging from 30 to 40 years of age. This is near the lower limit of the cancer age and would indicate that the rays may exert a powerful influence towards malignancy.

(2) The periods of exposure (not continuous of course) preceding the appearance of the cancer varied from three to eleven years. These periods exceed any that have been used experimentally and seem to indicate that chronic irritation, or perhaps it would be better to say chronic radiation, may produce malignancy if continued long enough regardless of the age of the subject.

(3) Malignancy has occurred only where the direct rays have had access to the skin. Even thin clothing has served as a protection. It is very possible, therefore, that only the very softest and least penetrating rays are responsible for the changes noted.

Chronic roentgen ray dermatitis, that is, the type which was contracted by so many of the early workers who used no protection, shows certain definite features. The skin is dry and thick, the hair falls out, small telangiectases appear, the nails are ribbed, and keratoses are commonly found. Later the keratoses are more numerous, paronychia appear, chronic ulcerations heal and break down repeatedly and finally an epithelioma begins at the

site of an inflamed keratosis or in a chronic ulcer. Since the sequence of events in such cases seemed so logically arranged and since the etiological factor was so definite, Dr. S. B. Wolbach, who made a careful study of many sections of material removed by Dr. Porter at operation, felt that experimental cancer could be produced by repeatedly exposing the skin of animals to the roentgen rays.

This work was undertaken on a small scale, but the difficulties to be overcome were many and up to the present no malignancy has been produced. However, some of the findings are of sufficient interest to warrant a brief description. White guinea pigs were selected because fair skinned people seem to be most susceptible to cutaneous epithelioma. The bellies of these animals were shaved and an animal board was so equipped that when fastened upon it the entire pig, with the exception of an area 2½ cm. square on the shaved belly, was screened from the rays. A Coolidge tube energized by a Biddle roentgen-ray coil was centered over the square area in the screen at a fixed distance above it. Since there are no accurate instruments for measuring roentgen rays it was decided to use as a unit of exposure that dose just sufficient to produce an erythema of the skin. It was rather interesting to note that when this dose was given, the longitudinal dimension of the square area exposed began to decrease until at the end of 12 days it measured less than 1.0 cm., while the transverse dimension remained practically constant. On about the eighth day the skin became brown and by the tenth day a scaly desquamation appeared and the hair began to fall out.

In order to acquire a definite knowledge of just what changes occurred in the skin following the unit exposure, six animals were exposed in exactly the same manner and one was autopsied every second day thereafter and sections made of the exposed skin. Some of the more outstanding features in these preparations are given below:

(1) The *horny layer* begins to thicken at the end of four days and at the end of six days is considerably thickened, takes a deep stain, and shows some disintegration. At the end of 12 days much of the layer is desquamated and the remaining portions are dense and stain deeply.

(2) The *epithelium* shows rather marked changes. At the end of six days the cells are much enlarged and the nuclei are four or five times their original size. The sulci are much less noticeable than in the normal skin where they are very prominent. There is an occasional mitotic figure seen. At the end of 10 days the picture is much the same except that the epithelial layer has become much thicker. At the end of 12 days there are five or six layers of cells in the epithelium whereas there are only two or three such layers in the normal skin. Mitotic figures are easily found. The epithelial layer is much thicker than normal and the sulci are practically all smoothed out.

(3) The *hair follicles* are farther apart than in the normal skin at the end of eight days. After 12 days very few of them contain hair shafts and the central portions seem to be filled either with epithelial cells or with fibrous tissue.

(4) The *corium* shows changes which are perhaps the most interesting of all. At the end of two days the collagen bundles have increased to four or five times their former thickness and take a deep homogeneous stain. The spaces between the bundles are very much narrower and the connective tissue cells show no changes. At the end of 12 days the picture is practically the same except that the changes are more pronounced.

(5) The *blood vessels* show little reaction to the unit dose of roentgen rays. In some of the sections they seem to be dilated and are filled with blood cells, but in others this is not the case.

Having determined upon a unit, the next step was to study the effect of the repeated application of this unit dose to the same area. Many difficulties arose

in the course of this procedure. It was discovered after losing a score of the animals that when the unit dose was repeated within an interval of two weeks, the pig always died. It was also observed that the effect of the same dose became considerably greater with each repetition; that is, the skin seemed to become more susceptible each time it was radiated. Intercurrent disease carried off many of the pigs after they had been radiated for several months.

FIG. 1. SECTION OF NORMAL GUINEA PIG SKIN OUTSIDE THE RADIATED AREA SHOWN IN FIG. 2. THE HORNY LAYER IS INTACT, THE EPITHELIAL LAYER THIN AND THE COLLAGEN BUNDLES THIN AND RATHER WIDELY SEPARATED.

One of the animals lived for three months and ten days and during that time received four unit doses over the same area. Some 12 days after administering the first dose this area contracted, lost its hair, became brown, and began to scale. After the third dose it took on a purplish color and a black crust slowly formed. After the fourth dose this crust began to separate at the edges leaving a raw ulcerated surface below. It is rather strange that at no time did this surface become infected. The last two exposures were too close together and the animal died with the signs shown by all of those which received too frequent radiation; that is, it became emaciated, too weak to stand, and developed a diarrhœa. The actual cause of death may have been some infection but the primary cause was undoubtedly a toxic roentgen-ray effect. Sections including the ulceration and the normal skin on either side of it were made and stained with phosphotungstic acid hematin.

The slough is composed entirely of fibrous tissue, the epithelium over this

FIG. 2. SECTION OF SKIN FROM ABDOMEN OF GUINEA PIG 12 DAYS AFTER RECEIVING THE UNIT DOSE OF ROENTGEN RAYS. THE HORNY LAYER IS THICKENED AND DESQUAMATING, THE EPITHELIAL LAYER IS THICKENED, AND THE COLLAGEN BUNDLES ARE THICKENED AND IN CLOSE APPOSITION. MAGNIFICATION SAME AS IN FIG. 2.

area having long since disappeared. The outer layer takes a deep blue stain and apparently is dead and degenerating. Beneath this there is a stratum taking a pink stain and consisting of very much swollen collagen bundles closely packed together, giving the layer a hyaline appearance. Deeper still there is a layer of connective tissue which approaches the normal in structure. This slough seems to indicate that the effect of the roentgen rays diminishes rapidly as they penetrate deeper into the tissues. It is probable that the very soft roentgen rays are the ones which cause the changes in the colla-

gen fibrils and that they are absorbed before they reach the deepest layers of the corium.

At the edges of the lesion there exists an exaggeration of the condition observed in the 12-day slides. The horny layer is thinned out until there is little left of it, the epithelium is much thickened, the sulci are smoothed out, the hair follicles have for the most part disappeared, and the corium is thickened and shows the changes in the collagen bundles noted in the previous sections. In addition to these findings there are in two sections structures which have the exact morphology of epithelial pearls. Both of them are situated at the edge of the ulceration near the point at which the thickened epithelium leaves off. One is located in the corium and one in the epithelial layer itself. One can only conjecture as to the significance of these pearls, if they are such.

FIG. 3. VERY LOW POWER VIEW OF THE ULCER OBTAINED ON THE ABDOMEN OF THE PIG RECEIVING 4 UNIT DOSES. THE DARK STAINING SLOUGH IS DEAD FIBROUS TISSUE.

These few experiments show definitely that the collagen bundles and perhaps the epithelium also react markedly when exposed to the roentgen rays. Some explanation of this reaction should be advanced, but it is very difficult to explain why the roentgen rays which are supposed to be very rapid vibrations in that intangible medium known as ether should produce such changes.

The ionization theory would at once be brought forward by some. Ionization means merely the changing of a substance so that its conductivity for electricity is increased. Air and some liquids normally conduct little or no electricity, but while the roentgen rays are passing through them they are capable of conducting a quantity sufficient to be measured by a delicate instrument. That the normal activity of cells involves electrical phenomena is hardly to be doubted in the face of the electrocardiograph, the instruments for measuring the currents preceding striated muscle contraction, etc. Lazarus Barlow, an English scientist, states—that there is a definite amount of radioactive substance in the normal human body which he has been able to measure accurately. He also states that there is about 20 times as much of this substance in the body when malignancy is present. It may be possible, therefore, that interference with the normal electrical mechanism of the cell is responsible for its changes.

FIG. 4. HIGH POWER VIEW OF A SMALL PORTION OF SLOUGH SHOWN IN FIG. 3. THE DARK STAINING LAYER IS COMPOSED OF NECROTIC FIBROUS TISSUE. BELOW THIS LIES A ZONE OF DENSELY PACKED COLLAGEN FIBRILS. AT A STILL LOWER LEVEL THE FIBROUS TISSUE APPROACHES THE NORMAL.

However, ionization can hardly be said to be the only factor involved, for ionizing power has been shown to be proportional to the quantity of roentgen rays used regardless of their character. Since hard and soft roentgen rays in the same quantities are thought by many to produce different effects on tissues, other forces should be considered.

The chemical reactions following roentgen radiation have not been worked out sufficiently to help materially in explaining tissue changes. It has been shown that certain platinocyanides change color, that iodoform liberates chlorine, that inorganic colloids in suspension may be precipitated, that albumen becomes less viscous, and that starch shows a decrease in viscosity and opacity during radiation. Dr. Bovie, of the Cancer Research Commission, states that there is a marked increase in photo-instability of many of the proteins and amino acids as we pass from the sunlight region of the ultra-violet to the regions of higher vibration frequencies. It is in this region of higher vibration frequencies that the roentgen rays lie. It seems quite likely that some interesting facts will be revealed when the roentgen rays are applied more extensively in the study of bio-chemistry.

The biologist is perhaps the proper authority to turn to for information concerning the individual cell. The German investigator, Schaudin, in 1899 exposed certain forms of sporozoa, flagellata, and infusoria to the roentgen rays. Broadly speaking, he found the sensitivity to increase as the protoplasm became more fluid and the nuclei more numerous. Many of the organisms drew in their pseudopodia, became globular, and burst much as if they had absorbed liquid until they could hold no more. Since the exact structure of the collagen fibrils is not known, it is difficult to say whether the swelling of the bundles may be likened to the swelling of the one-celled organism. The increase in size of the epithelial cells is probably the same sort of a reaction. The influence of the roentgen rays on the developing cells in embryological life has been demonstrated by a number of workers. Ova may be killed outright or stimulated to such a degree that they produce all sorts of monstrous embryological structures. Since the cancer cell is supposed to take on the characteristics of the embryological proliferative cell, it seems quite probable that the rays should have the power of inducing malignancy.

Although this influence may be negligible in isolated skin exposures, the general effects of the roentgen rays should receive some consideration. A heavy dose administered to the whole body of an animal causes decided changes in the blood. A primary rise in the white count is followed by a marked fall. I was able to cause the white count of one of my animals to drop from 15,000 to 500 in four days by administering one dose of roentgen rays. This animal died with all the signs shown by the animals receiving too frequent exposures in the skin experiments. The red cells show a slight decrease but this change in no way compares with the one exhibited by the nucleated forms. Why the roentgen rays should pick out the nucleated cells in the bloodstream and the non-nucleated collagen material in the corium of the skin is not easy to explain.

One could hardly leave the field of conjecture without touching upon the glands of internal secretion. They seem to be the regulators that govern the functioning of many parts of the body. When the thyroid gland begins to exert undue influences upon the processes under its command, the roentgen rays have the power of returning the organ to something like its normal state of activity. When the ovaries become overactive and metrorrhagia results, the roentgen rays are capable of restoring their normal periodic functioning or of destroying it entirely. The testicle may be temporarily or completely incapacitated by irradiation. In some cases the enlarged spleen reduces in size rapidly after a few roentgen-ray exposures. None of these

phenomena may enter into the production of malignant growths and yet they should be considered.

This rather hasty and incomplete survey of the reactions dependent on radiant energy will, I believe, impress the reader with the futility of attempting to explain tissue changes on the basis of the data now available. Future experimentation will undoubtedly show relationships between some of the changes described.

SUMMARY

In summarizing the original work described in this paper, a few points may be worthy of emphasis:

(1) The skin covering the abdomen of a guinea pig shows marked contraction after receiving an erythema dose of roentgen rays. A similar condition has been observed by surgeons in the very dense fibrous tissue surrounding a tumor treated by roentgen radiation. It has also been observed that the vagina sometimes contracts so that it will not admit the examining finger after cervical malignancy has been treated with radium.

(2) Since the connective tissue changes are the first to occur following the exposure of guinea pig skin to the roentgen rays, it may be that the changes in the epithelium occurring some eight days later are secondary reactions due perhaps to an interference with nutrition.

(3) If a single exposure causes a stimulation of the epithelium as a result of changes in the corium, repeated exposures may so change the subepithelial structures that the epithelium is chronically stimulated and thereby finally urged on to active proliferation.

Dr. Wolbach in his article entitled "The Histology of Chronic Roentgen-Ray Dermatitis," published in 1909, described very pronounced connective tissue changes similar to those obtained in these experiments. His preparations also showed vascular obliteration and he suggested at that time that the primary cause of the malignancy following roentgen-ray dermatitis might very possibly be in the corium. He also called attention to the fact that Ribbert, Goebel and Wyss have advanced similar theories. It would be interesting to know whether the tumors produced on the ears of rabbits by the repeated application of coal tar showed any fibrous tissue changes in the early stages. It may be that these tumors which begin in the hair follicles are entirely different from those following roentgen-ray dermatitis.

Unfortunately, this paper has consisted for the most part of conjecture. The field of roentgen-ray experimentation is, as must be realized, very little exploited. That radiant energy is vitally related to the physiology of living matter seems evident. It has the power to stimulate tissues or to destroy them; it produces pathological structures and yet these same structures may be eradicated by it; it may produce a generalized disease followed by death and yet its judicious use often returns the diseased organism to a state of normal functioning. In a word, we have in our hands a most powerful agent for good and for evil. More careful study and experimentation are needed in order that we may derive from it only the good results.

LOCALIZATION OF FOREIGN BODIES AT THE FRONT

THE NEAREST POINT METHOD. THE PALPATING STICK *

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SINCE the beginning of the war medical periodicals have been over-abundant in articles dealing with the localization of foreign bodies. Case exhaustively reviews the literature of the Allies in 1918 on this subject and digests about two hundred odd articles showing the great similarity which exists in all of their methods. It is interesting to see how many of them employ, as their working basis, the well-known geometric principle of similar triangle construction.

My object in presenting this paper is not to add anything new in localization, but for the purpose of visualizing, to those not fortunate enough to get to France, of what localization of foreign bodies at the front really consists; of showing you the importance of employing a rapid, simple and fairly accurate method for this purpose, and briefly describing that method which we used.

This method has been used in scattered parts of France with slight variations in technic. The first description that I found of this method is that by Gordon Richards published in the *Journal of the Royal Army Medical Corps*, 1917, page 221, in which he describes it as a simple method of locating foreign bodies. No doubt it has been recorded many times but it was through the courtesy of our French colleagues that we first saw it used and this method, which ranks foremost as the one used in our army, surely should have a little more recognition than it has heretofore received.

I might state that the first roentgenologists who went to France after our entry into the war, were confronted with a different method of localization at each place they either visited or were stationed. These methods, generally speaking, had a tendency to become simpler as one approached the hospitals nearer the front. In fact, some of the base hospitals in Paris employed such tedious and complicated methods that I, personally, would have been months learning how to employ them.

I should like to state that mathematically accurate localization of foreign bodies is not necessary at the front. Why? Because the ability on the part of the surgeon to remove these projectiles does not depend so much upon the roentgenologist's skill in telling the surgeon how many centimeters the foreign body lies under a certain mark on the skin, but upon the surgeon's ability to do a thorough and complete débridement.

It is not my desire nor my duty to go into detail about how a débridement should be done, but suffice it to say that when done properly and the track of the projectile dissected out *in situ* the projectile will always be found at the end of this track.

On the other hand if the surgeon for some reason fails to follow or loses the track produced by the projectile, he will always experience more or less difficulty in finding the foreign body because the relationship of the muscles and marks on the skin have been altered or destroyed by the operation.

I mention these points because they are the real factors which exist in an evacuation hospital or any hospital situated near the front, and, combined with the huge numbers of patients that one is required to examine when working in an active sector, it is again evident why the most simple and speedy method be employed in this work.

My first real experience with roentgen ray work at the front came in September,

*Read in part before the Mid-winter Meeting of Eastern Roentgenologists, Atlantic City, N. J., Jan., 1919.

1917, when I was ordered, as roentgenologist on a surgical team, to the largest and best equipped hospital in the French army (Fig. 1).

This hospital, which was composed of wooden barracks accommodating four thousand bed patients, was situated on the Chemin des Dames front, eight kilometers behind the front line. From the grounds of this hospital we could see shells bursting in the trenches.

Those in charge of the work at this hospital were of the best in the French army. The roentgenologists were young, capable men who had been through this work for over three years and who knew all the tricks in localization.

The lessons which we learned at this place were very important, and subsequently had some bearing on the policy which was finally adopted in our army.

FIG. 1. BIRD'S-EYE VIEW OF THE FRENCH EVACUATION HOSPITAL AT VASSENY, FRANCE, NEAR THE CHEMIN DES DAMES, WHERE WE LEARNED TO USE THE NEAREST-POINT METHOD. THIS 4000-BED HOSPITAL WAS 8 KILOMETERS BEHIND THE TRENCHES AND WAS SUBSEQUENTLY BURNED IN THE FRENCH RETREAT ON THIS FRONT IN JUNE, 1918.

Among these lessons, we learned the importance of team work and organization of staffs into shifts, each shift usually working eight hours. The necessity of having a much larger number of trained men available was also impressed upon us.

Furthermore, it was at this hospital that we first became acquainted with the nearest point method of foreign body localization.

THE NEAREST POINT METHOD OF LOCALIZATION

The nearest point method of localization is the palpation, under fluoroscopic observation, of the soft tissues in the region of the projectile. The palpation of the soft tissues is done with a wooden stick about ten inches long with a metal screw or tack inserted into each end. This is known as the palpating or "joy" stick.

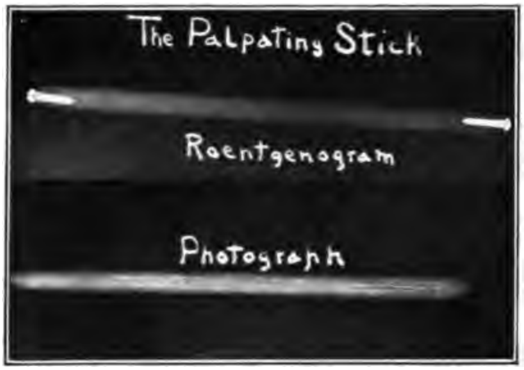

FIG. 2. ROENTGEN RAY AND PHOTOGRAPH OF THE PALPATING STICK.

Under the screen the nearly transparent wood can be only faintly seen while the sharp contrasted shadow caused by the metal screws is plainly visible (Fig. 2).

The purpose of palpating the soft tissues with this instrument is to determine whether the foreign body can be moved, and how much.

FIG. 3. LIEUT. IRA LOCKWOOD EMPLOYING THE NEAREST-POINT METHOD OF LOCALIZATION. NOTE THE MANNER IN WHICH THE STICK IS HELD.

By exerting light and deep pressure on the soft tissues with the stick it is possible to determine with fair accuracy the depth at which the projectile lies under the point on the skin surface where the pressure is made (Fig. 3).

Skill in this method increases with continued use and a sense of pressure is developed which proves a valuable aid in quickly estimating the depth of the projectile.

By holding one end of the stick against the skin surface and shifting the tube from side to side, the simple parallax method can be combined, which often helps a great deal in cases where the projectile is embedded in the bone or has entered the joint.

Generally speaking a projectile, in the soft tissues, which yields movement by light pressure exerted on the palpating stick, would lie about two to three centimeters under the skin.

If deep palpation is necessary in order to produce movement of the projectile, it is, I believe, safe to say the projectile lies about four to five centimeters under the skin.

The nearest point method is most applicable to localization of projectiles in the soft tissues of the extremities, the axilla and triangles of the neck, particularly, and also the scrotum and buttocks.

In cases where foreign bodies are located in the cranium, chest and abdominal cavities, the nearest point method has its least use. However, as I mentioned above, in combination with the parallax method used in bones and joints, it will still give the most accurate and quickest evidence in the localization of the projectile.

I realize this has been an exposé of an unscientific method used in the localization of foreign bodies; but it is for that reason that I wished to bring to your attention its great importance and practical use regardless of its unscientific principles.

REPORT OF CASE SHOWING AIR WITHIN THE CRANIAL CAVITY

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MISS L. H., aged 55, while crossing the street late at night, was knocked down by an automobile. She was unconscious when picked up and was still unconscious when brought to St. Luke's Hospital where she died several hours later. No operative interference was attempted. She sustained a scalp wound in the occipital region and numerous contusions of the face and body. There was some bleeding from the nose and mouth.

The roentgenograms was made the next morning, several hours after death.

The plates show numerous fracture lines involving both the vault and the base. A fracture of the right frontal bone extends into the right frontal sinus. A large crack in the base beginning in the floor of the sella turcica passes downward through the sphenoid sinus into the naso-pharynx. A large air space is shown in the frontal region.

ESOPHAGO-TRACHEAL FISTULA

REPORT OF CASE PROBABLY DUE TO SYPHILIS, COMPLICATED WITH A PULSION DIVERTICULUM *

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THE following case is presented partly because of the rarity of the condition itself, as only one or possibly two cases of esophago-tracheal fistula due to syphilis as recognized by roentgen ray examination have been reported; and also because it is the first case, so far as the writer is aware, in which such a fistula has been found to be associated with the presence of a pulsion diverticulum.

The patient was a man of sixty-five, a bronze worker by occupation, admitted to the Rhode Island Hospital on Nov. 18, 1918. He entered on the service of Dr. H. P. Abbott, through whose courtesy the writer has the privilege of reporting this case. The previous history was negative, with the exception of a story of dizzy spells off and on for the past two years.

Five months before entrance, while eating an apple, a piece stuck in his throat, after which he experienced a slight difficulty in swallowing. As it did not trouble him very much, the patient did nothing further about it. Two months later, he again noticed some difficulty in swallowing, and then began to vomit occasionally. This condition gradually grew worse. The dysphagia, which at first was limited to solids, was gradually extended to liquids. For eight or ten days previous to entering the hospital, the patient stated that he had not been able to keep anything but a small amount of liquid on his stomach. Immediately after swallowing, he would begin to cough, and finally vomit the food taken. No pain or soreness was felt in the throat.

Physical examination showed a well-developed but markedly emaciated man, who was coughing considerably. The examination of the heart showed that the sounds at the apex were regular but of poor quality. The aortic second sound was accentuated, and greater than the pulmonic second. A short, harsh, systolic murmur was heard in the aortic area, and transmitted slightly into the neck, but not to the præcordia. The area of dullness over the base of the heart appeared to be slightly widened. The examination of the lungs and abdomen was negative. The reflexes were normal.

Roentgen Ray Examination.—A small amount of a rather thick mixture of barium and buttermilk was given. Shortly after swallowing the mixture, a violent fit of coughing began. The patient was able, however, to hold his breath long enough for a stereoscopic set of plates to be taken in the postero-anterior position, as well as in the right anterior oblique position. The lungs, aside from the filling with barium, appeared to be normal. No evidence of pneumonia or other parenchymal disease could be noted.

The postero-anterior plates (Fig. 1) showed a definite pouch-like dilatation of the upper esophagus, with a smooth, rounded lower border, reaching to the level of the sternal notch. Below this pouch, the barium filling of the lower trachea was clearly visible, extending into the bronchial bifurcations on both sides. The further ramifications of the bronchi were also brought out, especially well on the right side. By stereoscopic study of these plates, the branching of the barium-filled bronchial distribution was seen with wonderful clearness. On these same plates, a diffuse dilatation of the upper ascending aorta, and also of the transverse arch, was observed, which resembled the aortitis due to syphilis.

* Read before the Providence Medical Association, Feb. 3, 1919.

The oblique view of the chest (Fig. 2) brought out the filling of the diverticulum especially well. Below this, the staining of the lower trachea, and the extension into the right and left bronchi, were clearly visible. The upper and lower divisions of the bronchus on the right side were easily distinguished. It will be seen that the lower border of the esophageal pouch is smooth and rounded, and does not show any irregularities or filling defects. No definite filling of the actual fistula could be made out, although a slight prolongation of the diverticulum was noted on the left side, in the postero-anterior examination. This may possibly represent the spot where the entrance is made into the trachea.

FIG. 1. ESOPHAGO-TRACHEAL FISTULA WITH DIVERTICULUM. THE DIVERTICULUM REACHES TO THE LEVEL OF THE STERNAL NOTCH. BELOW THIS, A SLIGHT BARIUM FILLING OF THE TRACHEA AND BRONCHI IS VISIBLE THROUGH THE SHADOW OF THE GREAT BLOOD-VESSELS. BARIUM-FILLED BRONCHIOLES ARE SEEN NEAR THE RIGHT BASE. THE AORTIC ARCH SHOWS THE DIFFUSE DILATATION OF SYPHILITIC AORTITIS.

FIG. 2. VIEW IN OBLIQUE POSITION. BELOW THE ESOPHAGEAL DIVERTICULUM BARIUM IS SEEN IN THE LOWER TRACHEA AND BOTH BRONCHI, WITH THEIR SUB-DIVISIONS.

From the roentgen ray examination, a diagnosis of esophago-tracheal fistula was made. The suspicious appearance of the aorta suggested syphilis. The Wassermann reaction proved to be strongly positive. After a slight amount of antispecific treatment, the patient left the hospital against advice. Forty-eight hours later he died. The details in connection with his death are unknown. No autopsy was made.

Fistula formation between the esophagus and trachea has been familiar to the pathologists for many years. All the text-books describe the condition and its various causes. According to Adami, the causes may be grouped as due to perforation from foreign bodies, pressure from retained foreign bodies, erosion from carcinomatous or syphilitic ulcers, extension of inflammatory conditions from without, caseous tuberculous glands, and aneurism. The most common causes are carcinoma of the esophagus and tuberculosis. A very few cases have been reported in which

syphilitic processes in either the trachea or esophagus were found to be the basis for the resultant fistula.

These fistulæ generally lead to bronchopneumonia, from the inhalation of food or other septic material. Sometimes this results in lung gangrene. In cases of carcinoma of the esophagus, the inhaled material may be not only food but also the products of degeneration of the tumor itself. In the present case, it is remarkable that nothing pathological was noted in the lungs, either by the roentgen ray or on the physical examination, although some food particles must have been entering the lungs for at least a week. The eventual death may possibly have been due to bronchopneumonia.

Although this condition has been known to the pathologists for some time, its recognition by means of the roentgen ray is a matter of very recent development. The older German textbooks make no mention of it at all. Groedel's Atlas of "Roentgen Diagnosis in Internal Medicine," published in 1909, does not mention this pathological condition. Gocht's handbook, published in 1911, is likewise barren in this particular. Even Rieder and Rosenthal's textbook (1913) makes no mention of these fistulæ, although the section on the esophagus was written by no less prominent an authority than Prof. Paul Krause.

The British authorities have also been somewhat lax in their attention to this particular field. Barclay's monograph (1915) barely mentions the condition in passing. The otherwise admirable textbook on Radiography published by Robert Knox as recently as 1917, does not give even a line to the acquired condition of fistula formation, although he does devote a small section to the consideration of the congenital type of fistula.

The French appear to have done somewhat better. In the textbook by Jaugeas, the author devotes an admirable section to the condition of fistula as produced by carcinoma of the esophagus, and describes a case which occurred in his own practice. This is accompanied by some very satisfactory prints. He also mentions the condition as described by at least one other French author (Desternes).

Most of the descriptions appear to have been made by American observers. In 1915, Beeler described a case where the underlying cause was probably syphilis, in which he succeeded in obtaining stereoscopic plates showing the bronchial tree outlined to a certain extent by the barium mixture. Unfortunately only a very small amount of opaque meal was retained, so that the exact anatomy of the esophagus above the fistula was not made out.

The following year, 1916, Guttman and Held reported a case due to cancer of the esophagus, and one month later Carman reported another similar case. The latter was subsequently included in Carman's textbook. Guttman and Held mention a case of Horner's, published in Vienna in 1907, in which it was claimed that a fistula due to carcinoma was diagnosed in the living patient by a combination of esophagoscopic and fluoroscopic examinations. Beeler's case, however, is probably the first in which satisfactory plates were made. Ponzio, an Italian, reported a case in 1915 due to carcinoma, said to have been recognized by roentgen ray examination; but the exact details of the study are not mentioned in the review available to the writer.

In 1916, Levy of Denver reported another case of fistula. In this instance the fundamental cause was probably syphilis, although no Wassermann was taken. The suspicion was directed on account of the healed ulcers found in the trachea at autopsy, and the suspicious history generally.

Syphilis of the esophagus is not a very common condition. According to MacCallum, the primary and secondary lesions are practically unknown in this section of the digestive tract. The tertiary lesions or gummata sometimes arise in the submucosa and rupture so as to produce ulcers.

When these ulcers heal, they give rise to stricture of the canal.

In the present case, although we have no absolute pathological proof, it seems very probable that a stricture of the esophagus was slowly produced near the level of the sternal notch during the course of several months. Probably the original transient difficulty in swallowing was due to the first specific lesion in the esophagus. As the cicatrix contracted, the swallowing became more and more difficult. This particular region of the esophagus is a place where a diverticulum can be very easily produced by pressure, on account of the fact that there is a deficient musculature in the walls here, from remnants of the embryonic gill-clefts. It is at this level that most pulsion or pressure diverticula are found. In the present instance, the pressure of food taken into the esophagus against the gradually increasing syphilitic stricture was probably sufficient to produce the pulsion diverticulum. In order to explain the addition of the fistula, it would seem reasonable to believe that a later activation of the syphilitic process took place, with the production of another ulcer near the same level. This ulcer evidently perforated into the trachea about a week before the patient entered the hospital. The fact that the Wassermann reaction was very strongly positive points to the activity of the syphilis.

The age of the patient, and the fact that he was emaciated at the time of examination, might give rise to the suspicion that perhaps the fistula was not due to syphilis but to carcinoma of the esophagus. The mere fact that a syphilitic aorta and a positive serum reaction were noted does not prove that the perforation itself was due to a syphilitic process. Only recently Dean and Gregg have reported a case in which carcinoma, tuberculosis, and syphilis were found coexisting in the esophagus.

In all the published cases of carcinomatous fistula, where the condition of the esophagus is mentioned, the usual characteristics of esophageal cancer are found, namely, irregularity of the region of the stricture perhaps with evidence of infiltration of the esophageal wall by the tumor. In the present case these are absent. Instead, there is a smooth-walled diverticulum, which is much more consistent with the result of pressure against a slowly constricting syphilitic scar. The emaciation is easily explained by the lack of sufficient food taken during the course of several months.

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DISCUSSIONS OF PAPERS PREVIOUSLY PUBLISHED IN THE AMERICAN JOURNAL OF ROENTGENOLOGY

OSTEOMALACIA (NOV., 1918)

DR. HOLMES.—Dr. Evans spoke of the importance of the presence of calcium in the urine as a diagnostic point. I referred to that in my paper, but probably did not lay sufficient stress upon it.

As regards the disease being confined to the lower extremities, I did not wish to state that as my belief; but one author whom I quoted did say that he considered it a disease below the belt line. Von Recklinghausen, in his very excellent work on the subject,—in fact by far the best,—calls it a general condition which may involve all the bones of the body; and I have no reason to disagree with him. Your pathologist has called attention to the fact that osteomalacia is a rare disease in this country. We both stated that it is fairly common in the Rhine Valley, and that is one of my reasons for bringing it to your attention.

MR. SNOOK'S PAPER (JAN., 1919)

DR. GRIER.—I would like to ask the speaker if making the plates with the glass side toward the patient, instead of in the usual manner, would obviate the difficulty of placing them in the stereoscope with the glass side out, which is bad because of the reflection.

MR. SNOOK.—Replying to the difficulty mentioned due to the reflections from the glass sides of the plates, I would say that the double reflections, the reflections from the glass surfaces, can easily be obviated by the proper adjustment of the blinds or curtains which accompany the ordinary commercial stereoscopes. When once the curtains are in correct position those reflections are all obviated. If they are not, take it up with the manufacturer and have him make it good. It is easy to make it good and the manufacturer will gladly correct it. When you once start the custom of using this method of viewing stereoscopic plates the comfort of vision and the ease of vision, with the lack of any misleading things that you must keep in mind, I am sure will greatly aid you. That was the only purpose I had in mind in emphasizing this idea to you. If anyone wishes to discover for himself the amount of the distortion, I have brought with me some experimental plates that I would be glad to place in the stereoscope to let you study them and to let you experiment with them to convince yourselves of the amount of the error and the amount of the distortion of which I have spoken.

When double-coated films are used, I would suggest a simple method of overcoming the difficulty. Use the little wood block with its nail as a footpoint marker in the manner I have suggested; before development take an ordinary lead pencil and mark the anterior surface of the film with the lead pencil. That lead pencil mark will stay on the plate during development and fixation and, when the plate is dried, will be on the side of the plate that was towards the x-ray tube.

As to the holders for the films, I am not in position to solve that problem. With respect to the tilting of the tube, I wish to say that it makes no difference whether the tube goes from here to China and around back again, or whether the tube is tilted or not, except in so far as the absorption by the glass of the bulb is concerned. As long as the focus spots are the two and one-half inches apart at the times of exposure and the field of x-rays gives a satisfactory image without appreciable absorption by the glass there should be and there is no difference, in the resulting stereoscopic image, as to whether the tube is tilted or not.

DR. EDMONSON'S PAPER (JAN., 1919)

MAJOR F. H. BAETJER.—Dr. Edmonson has really covered the subject so thoroughly that there is not very much to say. I only want to add one thing to what he has said; that is, in connection with the thorium injections. These injections should never be done by the roentgenologist but by a skilled urologist. If it is done by one accustomed to doing it, the results are much more satisfactory, because injecting the ureter is really a very delicate matter; and, in the second place, we minimize the danger to the patient. Fortunately, with thorium, that danger has been reduced very materially. With the injection of collargol a number of fatalities have resulted. That is one of the reasons why we look around for another medium for injection. In consideration of the kinks of the ureter, one wants

to be very careful not to mistake a spasm of the ureter for a kink. If your injection is run in at all rapidly, you are pretty apt to produce a spasm and above that spasm there may be a dilatation of the ureter, not a true dilatation, but a temporary dilatation, due to the spasm; and unless one is careful, one can mistake that for a constriction.

One other exception I would like to take to Dr. Edmonson's paper. I doubt very much, indeed, whether it is justifiable to make a routine thorium examination of the kidneys and ureters. It seems to me that that ought to be the very last thing we should resort to, because, even in the hands of the best, there is always a certain amount of danger attending this operation. It is only when all other means fail that we should resort to it.

Major A. L. Gray.—I want to say a word in regard to the importance of obtaining a knowledge of the kidney functions before operations on the kidney. Surgeons too frequently assume that the other kidney is doing its work properly without obtaining definite assurance that this is true. I am not an advocate of ureteral catheterization and thorium injection in every case, but I doubt whether it is ever excusable to remove a calculus without at least draining the ureters to determine the function of each kidney. Of course we have no statistics at hand, but it is probable that a great many fatalities have resulted from operations for the removal of calculus without knowing what the other kidney was doing.

I have in mind a prominent physician in our state who had suffered from repeated attacks of renal colic and who had a roentgen examination made for stone. He was found to have stones on both kidneys. The left kidney had a very large calculus; the right had two very small ones. Before submitting to an operation his ureters were catheterized. He was found to have three. The most natural procedure would have been to remove the large calculus. If it had been done, and that kidney materially damaged, there would have been one less distinguished physician in the state of Virginia. The other kidney, the one that had two ureters, was absolutely functionless. He is now living, in active practice and in fairly good health, with all his calculi in his kidneys.

I merely want to add a plea, not so much for the roentgenologist, because it is not his part of the job, but that the surgeons will demand kidney functions on all cases of urinary calculus which are to undergo operation.

Dr. Ashbury.—The question of iodide of potash brings to mind some studies made in the use of thorium versus the use of iodide of potash in 25 and 30 per cent solutions at the Army Medical School. Everyone realizes the value of thorium. I don't know of any ill effects reported from the use of thorium. Some time ago an article appeared in the *Journal of the American Medical Association* recommending the use of solutions of iodide of potassium and sodium in strengths from 25 to 33 per cent for pyelography. It looked good. Iodide of potash is always available and the solution is very readily made. About that time I was asked to report on the use of thorium; and in connection with our report we used iodide of potash, also. Before injecting it, however, we made some pharmacological studies by injections into rabbits and guinea-pigs. All of our rabbits died immediately following intravenous injections of about 3.7 grains of iodide of potash. Our guinea-pigs were injected subcutaneously, and developed within 36 hours an ulcer anywhere from three-quarters to one and one-half inches in size. We then stopped the investigation because we felt that the use of iodide of potash, causing such solution of the tissues, was impractical for use in the urinary tract.

Dr. Edmonson (Closing).—Mr. President, relative to the remarks of Dr. Baetjer, I want to say that he is exactly right. I would not undertake, under any conditions, the cystoscopist's task, although I have had considerable experience in catheterization. My experience with collargol is quite limited. I have never seen ill effects from injecting a ten per cent solution of silver iodide put up in quince seed emulsion. On the other hand, it has been my observation that in cases of marked pyelitis it has acted as an excellent antiseptic astringent. I have never used potassium or sodium iodide. Dr. Gray's remarks are very important. The functional test of the kidneys should always be routine work before the injection is made.

[*See* Journal of Roentgenology, October, 1918, p. 468.]

Dr. Bissell.—If I may presume to occupy a little more of the time of the Society, taking part of my closing time, I want to say that it is quite a disappointment to me that there has been no discussion of my paper. Perhaps it is not worthy of discussion; but when one presents a paper without borrowing, as in the present case, one usually has an object for doing so. My reason in this particular instance was that I wanted to get some of the views of this Society, for whose opinion I have considerable respect, as to the merit of the classification which I presented. It is not a thing that is developed in a few moments. I have been working on this same classification, using it for several years, and have found it practical. I believe that any man who will use something of the kind will find it a practical classification. So far as I know, in looking through the literature, I have not found any which was practical from the standpoint of the roentgenologist. There are many different classifications. Tuberculosis has been classified and reclassified, until it would seem that there was no possible classification which had not been touched; and yet, from the standpoint of the roentgenologist, all have been absolutely impractical. I would not presume to establish any standard as a practical thing if I had not worked with it rather extensively and had the advice and support of the very best clinical men.

Before the war started and our men became scattered, I had unusual support from clinicians and pathologists. We felt that by combining the roentgen observations and the clinical observations, by getting together, as it were, on those things, we could in a very early stage tell what particular type of tuberculosis we were dealing with and make our prognosis accordingly.

COMMUNICATIONS FROM THE WAR DEPARTMENT

It is requested that each officer of the Medical Corps, U. S. Army, who was engaged in the *x*-ray service and who has returned from overseas, will prepare and send to Lt. Col. G. C. Johnston, Chief, Section of Roentgenology, Office of the Surgeon General, a short description of his experiences in the *x*-ray service of the Army while abroad, for incorporation in the Medical and Surgical History of the war. Due credit will be given to each author for the portions of his narrative used. The history of the *x*-ray service will thus be written by those men who helped make it. In reply refer to S. G. O. 700.7.

MEMORANDUM for Editors of Medical Periodicals.

As stated in the circular memoranda for Editors of Medical Publications issued by the Surgeon General's Office on March 27th and May 22, 1918, it is required by paragraph 423, Manual of the Medical Department, that all medical manuscripts by medical officers, U. S. Army, intended for publication shall be first submitted to the Surgeon General's Office, Washington, D. C., for approval. This regulation, which has been very courteously complied with, to date, is still in force as far as medical officers on active duty are concerned. In the case of medical officers recently retired from active duty, it is requested, as a courtesy to the Surgeon General and in aid of assembling material for the Medical History of the War, that all medical manuscripts based upon military or official records or upon military experience during the War, be submitted as heretofore, to the Secretary, Board of Publications, Surgeon General's Office, Washington, D. C., for record and approval and that such MSS. be accompanied by a carbon copy. Upon approval, the original copy will be forwarded to the journal designated, for publication, and the carbon will be filed in the records of the Medical History of the War.

For The Surgeon General:

(Signed) C. R. Darnall,
Colonel, Medical Corps, U. S. A.,
Executive Officer.

THE AMERICAN JOURNAL OF ROENTGENOLOGY

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JAMES W. SQUIRES

The death of Capt. James W. Squires of Charlotte, N. C., which occurred December 16, 1918, at the Justice Hospital Group in Toul, France, deprives the South of one of the most highly prized and ablest of the younger medical men of that section. Capt. Squires went to France as Roentgenologist with the Yale Mobile Hospital Unit August 21, 1917. Prior to joining his Unit he received military training for two months at Fort Oglethorpe, Ga., later being detailed for some intensive roentgen ray work at Cornell University. Arriving in France Sept. 17, his Unit marked time at Limoges, Haute Vienne, and then proceeded to the Lorraine Sector where Capt. Squires by unremitting energy and skill set up and operated (first at Aulnois, later at Chaillon) equipment of French pattern coördinated into a field-plant which was second to none in any of the combat zones. By September, 1918, just prior to the St.

Mihiel offensive, he received the full American equipment. At this time, he and his half dozen assistants had in operation three sets of rooms fully equipped giving direct access to the operating pavilion, besides manning a bedside equipment. The chief of this remarkable localization service,

installed at a distance of only six miles behind the enemy lines, gave himself too unreservedly to his task of orienting the surgeons. The operators could handle 200 cases a day, and this, with multiple localizations practised on patients difficult in the extreme to manipulate, put a death-dealing strain upon the chief roentgenologist. Capt. Squires fell a prey to lobar pneumonia and died on the very evening that his Unit received the first intimation of its return home.

Born November 2, 1888, at Matthews, N. C., James Williamson Squires lived in Charlotte from his fifth year. He graduated from the High School there in 1906, at the head of his class, and from the North Carolina Medical College in 1911, with a four-year standing of 93.5. On April 12, 1912, he married Eunice V. Jeffries, who bore him a second son on the day he sailed for France. In 1913 he took the course in roentgenology at Johns Hopkins, where already, as a North Carolinian undergraduate, he had taken some postgraduate work in medicine. In fact he had shown great assiduity as a postgraduate student, having worked at the New York Post-Graduate Hospital and Rockefeller Institute the year of his marriage. This competence as a student and deft efficiency as a technician were accompanied by a never failing courtesy and kindness of heart which won for Dr. Squires an immediate success at home. He developed his technique; by leaps and bounds knowledge grew in him concerning the "Ars et Mysterium" of roentgen ray. In practice he was associated with his uncle Dr. A. J. Crowell, who showed a parental devotion to him throughout his busy brief career. The death of Capt. Squires is a heavy loss to that large section of the Carolinas which in life he served, and to the American Roentgen Ray Society of which he was a most lovable and able member.

TRANSLATIONS & ABSTRACTS

SAMPSON, H. L., HEISE, F. H., and BROWN, LAWRASON. From the Trudeau Sanatorium, Trudeau, New York. A Study of Pulmonary and Pleural Annual Radiographic Shadows, Together with Notes on Interlobar Fissures. (*Am. Review of Tuberculosis*, 1919, Vol. II, No. 11, p. 664.)

The authors set out to show that many annular roentgen-ray shadows are not intrapulmonary cavities, as they have been described in a number of articles dealing with silent or unrecognizable cavities, but are in reality in many cases interlobar pneumothoraces or hydropneumothoraces and intrapleural. They may be situated between the lung and the chest wall.

A brief summary of the literature follows relating the specific clinical signs present in prevalent interlobar pleurisy. Following this, the roentgenographic study of intrapulmonary cavities is taken up in the following text: "That nearly all intrapulmonary cavities cast either a simple rarefication or a 'rarefication complex' on the plate or screen is quite probable. Whether or not these areas of greater transmission of ray are seen depends upon the size, shape and position of the cavity and the density and character of the adjacent tissue. There is probably no single roentgenographic manifestation or combination which is diagnostic. . . .

"The absence or marked diminution of lung markings inside an area or areas of rarefication is the most dependable, and if the size and position of such an area or areas are taken into account a diagnosis of cavity can be made with much assurance. . . .

"A somewhat circumscribed area of rarefication inside a consolidation or marked infiltration is also of much value and fairly reliable. . . .

"A manifestation that leaves one in much doubt as to its diagnostic value in relation to intrapulmonary cavity is the annular or ring-like shadow, varying in shape, seen many times in normal or mildly infiltrated lung fields, and it is this picture that we have attempted to investigate. . . . Many times more ray is absorbed inside these annular shadows than in the surrounding lung tissue; in a small percentage of cases more ray is transmitted through this ring; while in about 60 per cent of instances the transmission is the same. Lung markings are profuse in many of them even when the size is extreme, occupying an entire apex or upper third. . . .

"The profusion of lung markings, the greater or equal absorption of ray through these annular shadows, and also the fact that certain of them change their shape and size rapidly, make one skeptical as to their value in the diagnosis of intrapulmonary cavities. In many instances some as large as 3 to 5 cm. disappeared in from three to six months, or became larger and then smaller and finally disappeared."

The following table is given to illustrate the changes noted by the authors in fifty cases studied:

Enlarged, 18 per cent. Appeared where not previously present 20 per cent.
Diminished, 26 per cent. Increased and then diminished, 14 per cent.
Disappeared, 14 per cent. Change not known, 40 per cent.
Remained the same, 4 per cent.

"The character of these annular or ring-like shadows varies exceedingly. At times they are like a ring of dense fibrous tissue; at other times like a circular deposit of fibrinous exudate; and lastly they may also appear fairly broad (ribbon-like) and homogeneous. In many instances the lower margin is horizontal (possible fluid level). Seventy per cent of these shadows are above the third rib; the rest are scattered anywhere in the lung field."

In 423 consecutive cases annular shadows were found in 50 cases, or 11.8 per cent.

A most important contributory paragraph in this paper deals with a clear description of the course of the pulmonary fissures, which is in turn graphically illustrated by drawings and photographs of the location of lobes and fissures of the lung.

Physical signs of intrapulmonary cavity are discussed, and special emphasis is laid upon those cavities which contain fluid and air.

"A comparison of the physical signs, symptoms and other findings was made in the fifty cases showing these annular shadows in com-

parison with the clinical findings in another series of fifty cases where the annular shadows were not present. Both series were composed of cases with definite parenchymatous lesions. Pleuritic onsets and those with hemoptysis were of approximately the same frequency in both classes. Pleurisy with effusion occurred in only six per cent of the cases with annular shadows as against 14 per cent of those without. Dry pleurisy occurred with equal frequency.

"Physical signs of infiltration, or signs which could be interpreted as evidence of consolidation or cavity, occurred with equal frequency in each class of cases. Râles likewise occurred with equal constancy in both classes.

"Hemoptysis, however, occurred in a greater number of those cases that did not have the annular shadows. Yet on the other hand, streaked sputum without hemoptysis occurred more frequently in the cases showing annular shadows, 28 per cent as against 14 per cent without.

"The appearance of tubercle bacilli in the sputum played no rôle. 'The cases with annular shadows showed a greater tendency to relapse, a rather serious relapse occurring in 24 per cent of those with, and in only 8 per cent of those without.'

SUMMARY AND CONCLUSIONS

"This study of fifty cases, unselected from a much larger number, has led us to conclude that annular shadows, surrounding areas of increased or equal absorption of the ray, occur in patients more likely to be suffering from pulmonary softening, and indicate rupture of the lung.

"Owing to the presence of adhesions only partial pneumothorax with or without fluid results. The site of the pneumothorax depends upon the location of the softened focus and usually occurs in the upper part of the greater oblique fissure and in the horizontal fissure on the right. These pneumothoraces can rarely be diagnosed clinically and indicate a somewhat graver prognosis."

Beautiful photographs illustrating the lobes and fissures, and roentgen ray reproductions showing numbers of these ring-like shadows, accompany the article.

CHARLES A. WATERS.

COLLIN, E., PONTOPIDDAN, B., AND SCHOU, H. I. Light in Treatment of Tuberculosis of Bones and Joints. (*Ugeskrift for Læger*, Copenhagen, Nov. 21, 1918, 80, No. 47. Ref. *Cur. Med. Lit.*, Vol. 72, No. 6, p. 462.)

Collin declares that rational phototherapy is still in its infancy, notwithstanding the great advances made in recent years under the leadership of Finsen, Rollier and Reyn and Ernst. The two latter in the last five years have demonstrated that the light treatment alone, without the co-operation of climatic influences, cured as effectually at the Finsen Institute at Copenhagen as Rollier's mountain climate sunbaths. They proved that artificial light can take the place of sunlight from the therapeutic standpoint. The arc light rays seem to be more potent than any other source of radiant energy, although some prefer the quartz mercury vapor light. As the latter is less expensive to install, the two seashore sanatoriums for tuberculous children in Denmark are equipped with this, and Collin here reviews the experiences with 138 tuberculous children given this treatment after they had failed to show improvement under the general measures alone. They were thus the severer cases; in 102, general light baths were given, in 52 merely local, and in 34 regional baths, in some associated. The average length of the course of light treatment was five months; the range was from six weeks to ten months. All this material is described in detail, with the technic shown in illustrations and the outcome.

Recent re-examination shows that there has been recurrence in 13 of the 138 cases; in 11 of these 13 cases the course of phototherapy had been less than two months. Evidently the treatment was arrested before it had answered its complete purpose. In the remaining two cases, the children had other tuberculous lesions besides those that had been treated. The results in the total 138 cases must be regarded as extremely favorable. The seashore environment may have contributed, but as this alone had shown no benefit beforehand, it need not be taken much into account in estimating the outcome. The relatively rapid cure, the absence of disfigurement and the good functioning of the limbs are special advantages of this phototherapy. The experiences related impress the wisdom of sending children with tuberculous processes in glands, bones or joints to a seashore

sanatorium and supplementing the ordinary measures with courses of light treatment, sunlight, arc light or quartz lamp.

In 108 cases the tuberculous lesions seem to be cured; in 20 there was great improvement, and in 12 others some improvement. No benefit was observed in 16 cases and the lesions progressed in four; these were cases of spondylitis or white swelling of the knee. All of the gland cases and tendon sheath cases and cold abscesses were improved or cured. The children were between 4 and 15. In one case ichthyosis subsided under the light treatment applied for a tuberculous process. The children sometimes develop fever under the exposures, and recurring febrile bronchitis was not infrequent. The latter may have been the result of chilling during the exposures—the quartz lamp does not generate much heat—or it may have been from activation of latent tuberculous peribronchitis. There was complicating pulmonary tuberculosis in six cases, and in four the exposures had to be suspended as the condition was aggravated by them. This group includes the two spondylitis cases. Keratoconjunctivitis developed in 12 cases, and he queries whether this was due to injury of the eyes from the light, or activation of a latent process, or the result of the universal reaction to the toxins. The latter seems to him the most plausible explanation. An epidemic of varicella in the sanatorium did not spare the exposed children, and the pustules seemed to be extra large in them, resembling actual variola. Erysipelas developed in five cases, apparently uninfluenced by the phototherapy.

Clark, William L., Philadelphia. Cancer of Oral Cavity, Jaws and Throat. (*Jour. of A. M. A.*, Oct. 17, 1918.)

The author has, after study of the results of treatment in about 200 cases, found what a great success the electrothermic coagulation method has had, alone as well as combined with roentgen rays, radium, and surgical interference. He came to the conclusion that one electrothermic operation was sufficient for the destruction of malignant tumor in the oral cavity and the pharynx.

The methods used are the electrodesiccation and electrocoagulation; the first does not produce so intense a heat as the other, and is best suited to the destruction of such small, localized growths as may be found on the vocal cords, etc. By electrocoagulation a very penetrating and intense heat is produced, and is utilized for the destruction of the larger growths and also for bony involvements. Both methods are produced by high frequency currents and applied by steel needles that might be sharpened for the purpose.

If the parts involved cannot be exposed sufficiently by means of retractors or mouth gags, surgical measures must be practised, and extirpation of the gross mass of malignant tumor is also done by means of surgery, with electrothermic treatment following immediately to check hemorrhage and further destroy tumor tissue; also cervical glands can be removed followed by roentgen ray treatment in this region to prevent recurrency. Roentgenotherapy and radiotherapy following diathermy have proved to be very beneficial.

The author found that most cases of cancer of the mouth occur in males, especially where the oral toilet has been neglected and bad dental work and excessive smoking have caused a chronic inflammation. Cancer is also often found in combination with lues and tuberculosis.

Success in this treatment is only obtained where there is no cervical metastasis and where an absolute eradication of the last spot of diseased tissue is produced.

In most of the 200 cases treated, roentgen rays and radium had been used previously without success.

The 200 cases were divided into two groups; first, those distinctly localized with a favorable prognosis, and second, the conditions with metastasis to still movable cervical glands with a rather guarded prognosis. The numerous badly advanced cases with extensive primary lesions, adherent glands and involvement of other organs were treated without any thought of cure.

The author charted up the cases treated following anatomical locations. The best results were obtained in cases of localized involvement of the lower lip, while carcinoma of the tongue and larynx and surrounding organs showed a tendency to recurrence. In cases with metastasis recurrence was the usual thing; but if the lesions occur only locally there is always a chance for cure and success.

P. M. Lund.

GRANGER, AMEDEE. Improved Model of the Granger Localizer. (*Am. J. Electrotherap. & Radiol.*, April, 1918. Original presentation *New Orl. M. & S. J.*, Jan. 1918.)

The author describes his instrument, which applies the well-known parallax principle of foreign object localization. Its use simplifies the operation of obtaining equal shadow shifts of the foreign object and the auxiliary body (parallax indicator) which must be obtained in the determination by any parallax adaptation of the plane upon which the object lies.

An aluminum base has three wires placed lengthwise, the center one of which is in the center of the base, the other two parallel to it an equal distance on each side. Three shorter wires lie across these, the center crossing of which forms a central cross. The base is adjustable with reference to an upright support or post which carries two arms, a parallax indicator and a horizontal screen support. A scale is graduated on the upper surface of the base, zero of which is the central cross. A somewhat similar scale is found on the upright post; the sleeves supporting the two horizontal arms permit vertical and horizontal movements.

In use, the base of the instrument is inserted between the underside of the patient's skin and rests upon the table surface. The shadow of the foreign object being found, the center cross of the base is brought to lie in vertical line with the projectile, using a narrowed diaphragm, and the pierced center of the screen is likewise brought to the same line. The diaphragm is now opened and the tube displaced to right or left until the shadow of the projectile falls upon the shadow of the lateral wire. The parallax indicator is raised or lowered until its shadow falls upon the same lateral wire shadow as that of the projectile. The parallax pointer is now upon identically the same plane as that of the foreign object, and the distance from the underskin surface may be read upon the upright scale. The parallax pointer is next advanced horizontally until it touches the skin. With the screen resting upon the patient, the distance to the projectile is obtained by subtracting the distances of upper and lower sleeves from the base. The parallax pointer is then dropped to the base and its end compared with the scale on the base, which will indicate the distance laterally from the skin to the projectile.

The instrument is light, convenient and easily applied, and gives accurate measurements of these distances.

E. S. BLAINE.

DANDY, WALTER E. Fluoroscopy of the Cerebral Ventricles. (*Johns Hopkins Hosp. Bull.*, Feb., 1919, Vol. XXX, 336, 29.)

With the appearance of this paper another decided mark of advancement has been added to surgery and roentgenology. "Fluoroscopy of the Cerebral Ventricles" is the second paper to appear by Dandy on outlining the cerebral ventricles by the withdrawal of cerebrospinal fluid from the ventricles by means of a long needle and two-way syringe and replacing the fluid withdrawn by air.

The author claims that the results have been quite as striking from a fluoroscopic point of view as those seen on the roentgen-ray plate. The ages of the patients examined under the fluoroscope have ranged from three months to fifty-five years. The ventricles were found to be almost as distinct in adults as in infants and young children, though harder rays were necessary in order to penetrate the thicker skulls.

From 20 to 350 c.c. of air were introduced into the ventricles in his series of cases.

As in other things a combination of two methods is often better than any single one, and the fluoroscopic method combined with the plates is advocated by the author, claiming that the fluoroscopic study yields the same results as a series of ventriculograms; by proper movement of the head, antero-posterior and profile views or any part of one or both of the lateral ventricles can be studied, and a composite picture of the ventricular system obtained. However, if the fluoroscopic method was adopted to the exclusion of the plates, no permanent or graphic records of the cases could be had. And further the interpretations made at a fluoroscopic examination are necessarily hasty impressions and depend largely upon the individual's personal equation, especially when the observer's experience is limited and the normal and pathological not well established.

The technique of the injection of air has been described in the first communication by Dandy on this subject.

The author does not make himself quite clear in the paragraphs given to technique, although he undoubtedly advocates the horizontal fluoroscope with the patient prone, rather than the upright and standing or sitting position. Each movement of the head temporarily disturbs this fluid level, which quickly reforms with rest, just as in pneumothorax. Since only part of the fluid in the ventricles is usually replaced by air, it is evident that the position of the head will determine the part of the ventricular system that will contain air or fluid at a given time. The movements of air in the ventricles is more difficult than in hydropneumothorax, because there are curves, angles and branches of the lateral ventricles and points of narrowing at the foramina. Since the lateral ventricles are paired and communicate only anteriorly through the small foramina of Monro, these difficulties become greater.

Beginning with a small amount of air in the descending horn of one of the lateral ventricles, by changing the position of the head one can observe the air passing into the posterior horn, then the body, the anterior horn through the foramen of Monro into the third ventricle. From the third ventricle it passes through the opposite foramen of Monro into the opposite lateral ventricle, and by reversing the movements of the head the air may be sent to the descending horn of this ventricle. The rapidity of transfer of fluid from one lateral ventricle to the other varies with the size of the foramina of Monro.

In advanced hydrocephalus much additional communication between the lateral ventricles results from large perforations in the septum lucidum due to absorption from increased intraventricular pressure. In normal or moderately enlarged ventricles there is an uneven distribution of air in the two lateral ventricles when viewed anteroposteriorly. Only in large ventricles with very large foramina of Monro or in which there are artificial openings in the septum lucidum, is the communication between the lateral ventricles ample to give an equal distribution of air on the two sides without careful manipulations of the head.

In advanced hydrocephalus, the two cavities are practically fused into a single space, so that the fluid in the two sides quickly assumes the same level.

The results from this method of study have been practically the same as from ventriculography. Either by ventriculography or fluoroscopy the dilated ventricles are pathognomonic.

Five cases are cited in the results of this work along with well chosen illustrations. Several times air was seen in the cisterna magna indicating the patency of all the ventricular foramina, but so far it had not been observed in its passage through the aqueduct of Sylvius and fourth ventricle. Normal sized ventricles were observed, and aside from the difference in size of the ventricles the air passes from one side to the other much slower, and more careful manipulations of the head are necessary to accomplish the transfer.

Charles A. Waters.

Brown, George E. Syphilitic Aortitis and its Early Recognition. (*Am. J. Med. Science*, Jan., 1919.)

The author gives an historical and pathological résumé of the subject. He points out the frequency with which the condition is overlooked during life, and the large percentage of cases diagnosed at autopsy. He shows the importance of a careful clinical examination, and states that the roentgen examination is by far the most important method for demonstrating changes in the aortic arch.

The following changes can be demonstrated by means of the roentgenogram:

1. Enlargement of the aortic shadow to the right. This is usually the earliest demonstrable change, as it is the portion of the aorta first involved in the syphilitic process.

2. Enlargement to the left, with obliteration of the normal aortic knob.

3. Enlargement both to right and left. Increased density of the aortic shadow is suggestive, as is also the reduction of the aortic pulsation when viewed fluoroscopically.

The author states that the normal aorta of a young adult man should measure five to seven cm. in the transverse diameter, and at the age of fifty years eight cm., somewhat less in women.

He believes that by use of a carefully prepared clinical record, plates taken in upright position at a distance of from six to seven feet, and a Wassermann test, we shall be able to diagnose early syphilitic aortitis in a larger percentage of cases.

He concludes with an analysis of seven interesting cases showing that an early diagnosis should not be based on any one method used alone, but by a conjunction of the various methods.

J. H. MULLER.

PIRIE, A. HOWARD, Major, C. A. M. C. Localization of a Foreign Body in the Eye. (*Arch. Radiol. and Electroth.*, Nov., 1918.)

In this article the author reviews the various methods of eye localization, points out errors in the various methods used, and suggests a ball and mirror method of localizing foreign bodies in the eye which is mathematically accurate.

The following conclusions are arrived at:

In Sweet's method with a plate focus distance of 50 cm. and a 10 cm. shift parallel to the plane of the plate, a foreign body in the posterior pole of the eye is located 3 mm. too far back, a foreign body in the upper pole is located 1 mm. too far up, and a foreign body in the nasal pole is located .69 mm. outside the the eye. He then describes the ball and mirror method of localization. The apparatus is simple, accurate and inexpensive, consisting of a steel right angle, having attached to it a fixed ball and a small mirror, so that the adjustment can be accurately and quickly made. Two exposures are made and both instrument and foreign body are projected upon the one plate.

From the resultant negative one is able to tell the points perpendicularly above which the rays came from when each exposure was made; the tube shift, the point perpendicularly over which the ball lay, and the point perpendicularly over which the foreign body lay.

From the data, by means of triangulation and direct measurements, one can accurately locate the position of the foreign body.

The author also shows a table of measurements, made at a plate focus distance of 50 cm. and a tube shift of 20 cm. from which one can make direct readings if the same plate focus distance and shift have been used.

Having determined the position of the foreign body in the various planes it is necessary to know whether the foreign body lies within the eye. This can be done in various ways, by slide rule, model or a diagram table. The author advises the method suggested by Capt. Taylor, and publishes the table from which one can readily make direct readings.

J. H. MULLER.

(1) HARDY, WILLIAM F., St. Louis. Ocular Diseases of Dental Origin. (*Amer. Jour. of Ophthal.*, April, 1917, Vol. III, No. 3.)

Hardy's article is a partial review of the literature of this subject accompanied by what appears to be a fairly complete bibliography. The following remarks towards the end of the article seem worthy of transcription:

"The argument is raised that the connection between tooth and eye affections is too hypothetical and problematical, and that they are not related in cause and effect, but are coincidental. This view is based on the great prevalence of tooth affections and the relative infrequency of an associated eye disease. But the same is true of syphilis, gonorrhœa, and tuberculosis. How common are these and how relatively infrequent are ocular diseases the result of them. Yet no one disputes a syphilitic, gonorrhœal or tuberculous iritis or keratitis. It is incumbent upon ophthalmologists to consider the teeth in our list of possible ætiological factors, but to refrain from making of this possibility a hobby to be ridden to death." These remarks seem very much to the point.

(2) DOR, L., Lyon. Optic Neuritis Due to Dental Infection. (Névrite Optique par Infection d'Origine Dentaire.) (*La Clin. Ophthal.*, Sept., 1917.)

Dor has already given expression to his views on the subject of eye disease due to dental infection. He here adds reports of two cases which he holds are of this origin, though the case histories are incomplete in so far as the result of treatment of the teeth is not mentioned. He says that certainly readers are free to think that there is a simple coincidence between ocular affections of an "indeterminate" nature and the dental affection, but that those who consider the evolution of such cases of optic neuritis before and after the extraction of the teeth will quickly be convinced of the relation of cause and effect.

(3) Dor, L., Lyon. Thrombosis of the Retinal Veins Due to Dental Infection. (Thrombose des Veines Rétiniennes par Infection d'Origine Dentaire.) (*La Clin. Ophthal.*, Sept., 1917.)

Dor relates the case of a soldier who had thrombosis of the central vessels of the right eye with retinal hemorrhages and amblyopia ex anopsia of the highly myopic left eye. There was neither sugar nor albumin in the urine and no sign of syphilis. The dental condition was very bad on the side corresponding to the thrombosis. Four teeth with infected roots were extracted from this side of the upper jaw. The case is incomplete in so far as there are no observations as to the result, but Dor himself is satisfied as to the cause of the thrombosis being purely dental.

Ernest Thomson.

(3) Freund, L. Electric Diagnosis of Internal Ulceration. (*Deutsche med. Wchnschr.*, Dec. 5, 1918, 44, 1345.)

The writer calls attention to the information that is to be derived from the sharp local pain felt when a weak faradic current passes through any excoriation. He utilized it to detect any break in the skin in his hands before operations. He dipped his hand in the fluid of the hand jar of the "four cell electric bath" for arms and legs. The twinge of pain from even a hangnail showed at once the points to be protected with collodion. The method is applicable to the body cavities, stomach, bladder, rectum and vagina. For the stomach, he introduces a fine copper wire inside the stomach tube into the stomach, and passes a roller electrode over the surface of the body outside. The patient first drinks the barium contrast suspension, as roentgen examination usually is done at the same time. This thick suspension prevents any injury from the wire guide in the rubber tube. In sixteen persons thus tested, five complained of sharp pain at one or more points in the anterior wall of the abdomen. One of this group had a laparotomy later, and evidences were found of a healed invagination. The nine who responded negatively to the test were all clinically sound except one man with an atonic sagging stomach.

Taylor, Herbert D., Witherbee, William D., and Murphy, James B. Studies on *X*-ray Effects. (*Jour. Exp. Medicine*, Jan., 1919.)

1. *Destructive Action on Blood Cells.*—In order to determine the response of the blood cells to the roentgen ray, the authors gave fairly large doses to a series of susceptible animals. The animals used were the cat, monkey, guinea-pig, rabbit, rat, mouse and pony. Their susceptibility to the roentgen ray was found to be somewhat in the order just given. The most remarkable effect was a sudden decrease in the circulating lymphocytes. It appears, from their charts, that the total number of lymphocytes per c. mm. of blood, as determined by multiplying the total white count by the combined percentage of small and large lymphocytes before and after roentgen ray treatment offers a fairly accurate indication of the effect of the roentgen ray upon the blood. If this total number of circulating lymphocytes is plotted against the time in days, a curve is formed which reaches its lowest level 48 hours after the administration of the roentgen ray. There then follows a primary rise which reaches its height from 3 to 5 days after the last roentgen ray exposure. A secondary fall then occurs, which reaches its lowest level from 5 to 12 days after treatment, and this is followed by a secondary and, as far as could be determined, a permanent rise which persists for at least 6 or 7 weeks.

When the roentgen-ray treatments are distributed over a number of days, the results in the curve are somewhat confused because of the overlapping phases. In this case the primary fall in the circulating lymphocytes in the case of the animals given roentgen rays in several doses is really the result of a series of primary falls, and other phases may be somewhat lengthened.

It was found that animals of the same species respond to the same dose of the roentgen rays almost quantitatively.

When the lymphocytes are studied in terms of percentage of the total white blood cells, the results are not so striking. While in most instances their results showed a definite fall in percentage as well as in actual numbers of these cells after roentgen ray treatments occasional instances were encountered where the percentage change was slight or absent. This

they interpret as due to the fact that while in most instances the roentgen rays affect the lymphocytes selectively, occasional cases are found in which the granular blood cells are also destroyed.

The primary fall is accounted for by the destructive action of the roentgen rays on the lymphocytes as first experienced in the general circulation and in the sleep. In the meantime, the lymphogenic cells of the other organs, lymph glands, bone marrow, etc., contribute cells to the blood, these being responsible for the secondary transient rise. When all the lymphogenic tissues have been affected, the secondary fall in these cells is noted, but the low level characteristic of the primary fall is not reached because of beginning regeneration in the spleen. The permanent rise represents regeneration of all the lymphogenic tissues.

The polymorphonuclear neutrophiles have a tendency to show a slight primary rise 24 to 48 hours after treatment. This is followed by a primary fall which reaches its lowest level any time when the lymphocytes are beginning to rise. Later there is a gradual rise to normal. These cells are much less affected by the roentgen rays, and after the primary stimulation and later depression the return to the normal number per c. mm. occurs at a time when the lymphocytes are still at a very low level. Circulating eosinophils and basophils as well as large mononuclear and transitional leucocytes, usually share in the stimulations and depressions of the neutrophilic cells. This is as would be expected, as they all belong to the granular series and originate in the bone marrow which is later affected by the roentgen ray.

Summary.

1. Roentgen rays in large doses affect the lymphocytes before any of the other circulating cells.

2. There is a sharp fall in the total number of circulating lymphocytes, which is completed forty-eight hours after roentgen-ray treatment.

3. Following the immediate decrease in the circulating lymphocytes, there is a primary rise, followed by another fall, which in turn is followed by a permanent rise of these cells to normal.

4. The effect of the roentgen rays on different species of animals varies considerably, but in those studied, cat, monkey, guinea pig, rabbit, rat, mouse and pony, the selective action on the lymphocytes was in all instances apparent.

5. When several animals of the same species are given the same dose of roentgen rays, the effect on the circulating lymphocytes seems to be quantitatively parallel, when determined by blood counts.

6. The polymorphonuclear neutrophilic leucocytes, when affected at all, increase in number immediately after the administration of the roentgen rays and then tend to decrease below their normal level. This decrease is followed by a return to normal many days before the lymphocytes reach their original level.

7. The other cells of the blood follow the neutrophilic curve.

8. Percentage figures, as determined by differential blood counts, do not give an accurate indication of the effect of the roentgen rays. It is only when these are multiplied by the total white blood count that a figure, representing the total number of cells of the series per c. mm. of blood, is obtained, which varies to the stimulus in a constant manner, the variations being practically quantitative.

2. *Stimulative Action on the Lymphocytes.* While large doses destroy lymphoid tissues and produce a decrease in the circulating lymphocytes, small doses bring about a stimulation. The authors conducted two series of experiments, using brown rabbits. In the first series a dose of low penetration was applied to the dorsal area; spark gap ⅞ inch, milliamperage 25, target distance 8 inches, exposure time 20 minutes. In the second series filtered rays of higher penetration were used: spark gap 6 inches, milliamperage 5, target distance 10 inches, time 26 minutes and 57 seconds, three mm. illuminum filters. The animals of both series were otherwise exposed under identical conditions. The result showed that the roentgen ray dose of low penetration produced a definite stimulation which reached its maximum in from four to seven days after the rays were administered. The use of the largest spark gap with apparently the same dose, did not give a stimulation.

From their results, the authors suggest that the effect on the lymphoid organs is not the result of a direct action of the rays, but is brought about by secondary changes either in the circulating blood or in the superficial tissues; since the amount of roentgen ray of this

penetration reaching the deeper structures would be infinitesimal.

The difference in response of the individual animals is no more than that shown by individuals with normal counts who react differently in the number of cells thrown into the circulation in response to infections. They also note that it is conceivable that a marked stimulation may be taking place in the lymphoid organs without a proportionate number of these cells being thrown into the circulation.

3. *Changes in the Lymphoid Organs After Small Doses of Roentgen Rays.* "Iden. Ware Nakahara, Ph.D."—The author used the same dose of roentgen rays as used in the previous series. Animals were killed at intervals and tissues taken for study. Stimulation in the spleen becomes evident shortly after treatment and reaches its maximum in about four days persisting in a slight degree up to about fourteen days. The reaction in the lymph glands is somewhat quicker, appearing immediately after treatment and reaching its maximum in about two days. The small dose used had no appreciable destructive effect on the lymphoid tissues. The findings are compared with those observed in lymphositosis produced by heat. The author points out, however, that while apparently similar in nature the two phenomena are really different in that the lymphocytosis produced by heat is a sort of regenerative phenomenon, whereas that induced by the small dose of roentgen rays is due to the primary stimulative effect of the agent.

4. *Direct Action of Roentgen Rays on Transplantable Cancers of Mice.* "Iden. Hill, Elias; Morton, John J.; Witherbee, Wm. D." The authors selected the mouse cancer (Bashford Adenocarcinoma No. 63) and followed it through about fourteen generations of mice; half of the series was roentgen rayed between each transplantation. Their results seemed to show that while in the first few members of the series the percentage of takes was reduced and time of appearance was increased, in the later members of the series no appreciable difference was noted. In view of the fact that a proportion of cancers held in check for a time for roentgen ray treatment will later grow more rapidly, they raise the question as to whether workers in roentgen-ray therapy are justified in using a procedure which apparently only inhibits the cancer temporarily, while it incidently lowers the resistance of the individual to the growth.

A second series of experiments using less penetrating rays seem to show that rays of low penetration were apparently more harmful to the tumor cells than the more penetrating rays used in the first series.

HERMAN OSGOOD.

Radium in Cancer of the Upper Air and Food Passages. (*Revista Española de Medicina y Cirugia*, Dec. 1918. *Med. Rec.*, March 15, 1919, p. 457.)

Botey has used radium for these conditions since 1906, having begun with cancer of the nose. In superficial cutaneous epithelioma of the latter, excellent results are obtained by the use of radium in sessions of 30 to 60 minutes each. Ordinarily half a dozen sessions at intervals of 4 to 7 days suffice for cure. Of intranasal growths treated the great majority were sarcoma or myxosarcoma. Direct applications were made with but little filtration. A Dominici tube enclosed in one of brass is supported with a tampon, and left in the nose for from 6 to 24 hours. After 3 or 4 sessions the sarcomatous tissue melts away. Instrumental removal of parts of the tumor may be used in association with radium. Recurrence sometimes occurs but may be retarded by radium. In endonasal epithelioma results are mediocre, and this is also true of the same lesion in the mouth with occasional exceptions. In the fauces the only growths to be benefited are fibroadenomas. In malignant growths in this region any benefit is transitory. As for the larynx it has always been impossible to maintain a tube in its interior and the growths here are attacked through the skin. But results are poor and the author has spent much time in perfecting a technique in which intubation with or without tracheotomy serves for the introduction of a radium tube. He has made numerous applications of radium in this manner in which the external application is added as synergist. There is a conflict here because on the one hand the tolerance of the larynx for this treatment is limited and on the other hand large doses are in theory indicated. The reactions of the tissues are hostile to the development of the growth and favor autolysis of the cancer cell as well as production of fibrous tissue. It is believed, however, that radium sometimes favors re-

currence and all in all the author would limit this treatment to small and circumscribed lesions. Radium after extirpation despite its alleged unfavorable action on extensive growths in the direction of recurrence is also held to prevent the first beginnings of recurrence, this duality being difficult to comprehend. In tumors of the esophagus radium is an excellent palliative. The author treats cases of this nature by the application of tubes with the aid of the esophagoscope for the space of about 6 hours, repeating after an interval of from 4 to 7 days. The size of the tube is increased progressively. The sound and catheter can be used as the growth recedes.

SHOHAN, J. On the Need of More Frequent Roentgenological Examinations, Particularly in Head Injuries. (*Boston Med. & Surg. Jour.*, Feb. 27, 1919.)

The importance of roentgen examinations immediately after injury, is discussed, especially from the sociological standpoint. The relationship which fractures of the skull bear to epilepsy and other diseases is used as the base of the argument. The fact that fractures of the skull can seldom be made out after a certain length of time is emphasized.

SMITHERS, FRANK. Primary Carcinoma of the Gall Bladder; an analysis of twenty-three proved instances of the disease. (*Am. Jour. of Med. Science*, January, 1919.)

In reviewing 1,000 cases of proven gall bladder disease, the author found thirty-one cases of malignancy, twenty-three of which were primary neoplasms and eighteen secondarily invaded from adjacent viscera. He observed that the rate of incidence of gall bladder neoplasms is four times the frequency of primary·malignancy of primary neoplasms of the appendix, and that the gall bladder is involved fifth in frequency of the organs of digestion.

It is commonly asserted that malignancy of the gall bladder is found three times oftener in females than in males, and that gall stones occur in females in the same increased proportions; hence one might infer that gall stones bear the same etiological relations to malignancy of the parts. The author found, however, in his series of primary malignancy of the gall bladder, that there were sixteen males and seven females.

Out of eleven cases examined roentgenographically, five cases showed shadows in gall bladder region, strangely suspicious of calculi. Three cases showed interference with an emptying of the stomach with a six hour retention. One case showed a filling defect at the outlet of the stomach which was interpreted as a pyloric cancer. Fluoroscopic examination was a great aid in determining that the palpable tumor lay outside of the alimentary tract. In one case the malignant gall bladder involved the hepatic flexure of the colon, with resulting colon filling defect and retardation of the colon contents caudad.

Operative findings:

(1) In four cases the malignant change was well defined and located in the fundus of the gall baldder. In two cases there were malignant papillomata. In the remaining seventeen there was extensive involvement of the entire gall bladder with invasion of adjacent viscera.

(2) Histologically the lesion was constantly carcinoma of the columnar or spirocheta-cell type. Sixty-nine per cent of cases showed concomitant incidence of gall stones. A large per cent of the remaining cases gave histories suggestive of calculi. The question arises: Do the gall stones, acting as a chronic irritation, produce a malignant hyperplasia of the gall bladder, or do the gall stones result as a consequence of the cancerous change altering the excretory function of the gall bladder mucosa or preventing proper emptying of the viscus ?

J. H. MULLER.

WILLIAMS, A. WINKELRIED, M.B., C.M., D.P.H. The Use of Filtered *X*-rays for the Relief of Fibrous Bands and Adhesions Resulting from Bullet Wounds. (*Brit. Med. Jour.*, Dec. 2, 1916, p. 754.)

The successful use of the roentgen rays in keloid and hypertrophic skin scar suggested to the author that with the addition of filter, the same treatment might be of use in removing new fibrous tissue giving rise to trouble in deep wounds.

The same method was adopted in each case. The tubes chosen for the treatment were of

hardness seven on the Benoist scale. The rays were passed through a thin filter of aluminum 0.5 mm. A weak coil and a mercury dip break set to give 1,000 interruptions a minute, and requiring about 21,000 to 23,000 interruptions to give a Sabouraud dose of filtered rays, were used.

The details are given in four cases demonstrating the diminution of spontaneous pain and sensitiveness in the scar. We hope to hear further results of the application of *x*-rays as indicated in the title of the paper for the cases cited do not convince that there has been any marked success in the relief of fibrous tissue and adhesions although the diminution of pain and sensitiveness is definitely shown.

HAWES, JOHN B. Early Diagnosis of Pulmonary Tuberculosis. ("Medical Clinics of North America," Boston Number, January, 1918.).

The author reports cases with the diagnosis based on hemorrhage; constitutional signs and symptoms; fever and rapid pulsation; signs and symptoms referable to chest or lungs; on pleurisy with effusion. He has the following to say about the use of the roentgen ray:

"An *x*-ray examination may be of great value as an aid to diagnosis. I use the phrase 'may be of great value' advisedly. There are many hyperenthusiastic roentgenologists who claim that the *x*-ray will reveal tuberculous disease earlier and more accurately than can be done by any other method. It is undoubtedly true that the *x*-ray will reveal certain changes and abnormalities in the lung that cannot be detected in other ways, but it must always be remembered that *x*-ray evidence is based on lights and shadows, and that in most instances active and recent processes cannot be differentiated from inactive and old processes. Furthermore, the value of the *x*-ray plate, be it ever so clear and distinct, is dependent on the man who interprets the plate. It is true that the *x*-ray evidence, interpreted by an expert who recognizes the limitations as well as the possibilities of this method of diagnosis is of great value, but it is still more important to remember that such evidence should never take the place of a careful and painstaking history of the patient and the study of his constitutional symptoms and local signs in the lungs."

In a paragraph headed "Other causes of 'being run down,'" he states that any person who is in that condition runs the very serious chance of falling into the hands of some enthusiastic doctor who promptly labels him as a consumptive, and while he thinks that this condition is better than waiting for a positive sputum or other signs of the advanced stage, nevertheless it is a condition that ought not to exist.

He states, in conclusion, that the diagnosis of pulmonary tuberculosis is not an easy task; that it requires time, patience and thoroughness to make a correct diagnosis; that the patient's happiness, health and often his life depend upon the views of the physician given at this time. He concludes by saying that the "success in this field depends more on the use of common sense than on any other quality the physician may possess."

ERDMANN. J. F. Acute Diverticulitis of the Colon. (*Surg., Gynec. & Obst.*, February, 1918, Vol. XXIV, No. 2.)

The symptoms of acute diverticulitis are considered quite characteristic, but, if the symptoms are not acute, it is best to refer these patients for *x*-ray diagnosis.

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HEMORRHAGIC PNEUMONITIS * †

ROENTGEN RAY STUDIES DURING THE RECENT INFLUENZA EPIDEMIC AT THE WALTER REED GENERAL HOSPITAL, TAKOMA PARK, D. C., BEGINNING OCTOBER 1, 1918

BY. JOHN HUNTER SELBY

Major, M. C., U. S. A.

Chief of Roentgen Ray Section, Walter Reed General Hospital

DEFINITION.—An acute localized toxic inflammation of the cells lining the alvèoli, bronchioles, and their capillaries, producing a frank pernicious hemorrhage into the air passages.

Etiology.—It is undetermined what rôle, if any, the influenza bacillus plays in the production of the specific toxin that destroys the integrity of the cells lining the alveoli and bronchioles; but there is strong presumptive evidence to support the theory that the particular toxin which would seem to have a selective action upon these cells is produced locally by organisms which proliferate within air passages in the immediate vicinity of the lesions. This conception of the process is not offered to apply to any other lesion than hemorrhagic pneumonitis.

Occurrence.—The pathological literature on influenza epidemics antedating the present is said to contain no authentic description which conforms to the gross or microscopic appearance exhibited by these lungs, and similarly, no roentgen ray appearances such as we have observed have been described.

Hemorrhagic pneumonitis was recognized by the method of serial daily roentgenographs with the standard U. S. A. bedside roentgen ray machine, and was found to be present to a varying extent in 386 of the 470 patients referred. All of these, in one form or another, presented clinical evidence of pulmonary complication. The series included 3400 films. Observation on this condition, which we have called hemorrhagic pneumonitis and which we have learned to recognize as a definite roentgenographic entity, was subsequently confirmed by autopsy protocols.

Judging from the descriptions of the autopsy findings on these influenza cases that have come to our attention during the last few months, it seems that pulmonary hemorrhage is a conspicuous factor during this epidemic in all parts of the country. However, the degree of hemorrhagic involvement and also the percentage of hemorrhagic pneumonitis, as compared with streptococcic pneumonia and other variously described pneumonias, have varied considerably in different localities.

Pathology.—The microscopic findings

* Read at the Midwinter Meeting of Roentgenologists, Atlantic City, N. J., January 25, 1919

† Authority to publish granted by the Board of Publication, Surgeon General's Office, Washington, D. G.

have been variously described, some observers laying emphasis upon confluent bronchopneumonia, others describing bronchiolitis associated with more or less hemorrhage.

Captain M. W. Lyon, pathologist to the Walter Reed General Hospital, describes the typical lung appearance as follows:

"The external appearance of a freshly removed lung presents a slaty purple color. It feels firm and airless. Along the lower and anterior edges where there are air-containing and emphysematous lobules there is a sharp line of demarcation between the slaty portion and the air-containing portion, which is pinkish gray. In some cases there may be found air-containing islands in the slaty purple solid portions. In lungs which are incompletely involved, there may be found slaty purple islands in the midst of a pinkish gray field. Beneath the pleura, over the solidified portion, in many places, there are seen red hemorrhagic spots varying in size from less than a millimeter up to 3 millimeters in diameter. These spots have a tendency to coalesce and form large red areas.

"On sectioning the lung, using a sharp knife, without exerting any pressure upon the lung, the cut sections drip great quantities of blood. The cut surfaces do not appear mottled, but are homogeneous, without roughened areas or nodules. The general appearance strongly resembles a large fresh clot of blood."

We encountered a number of cases where several lobes would show a hemorrhagic pneumonitis, while another lobe presented a typical gray hepatization. The recognition of lobar pneumonia associated with hemorrhagic pneumonitis was possible in several cases by means of serial roentgen ray films made prior to death.

Other coexisting intrathoracic complications were encountered in order of frequency as follows:

1. Interlobar pleuritis.
2. Pleurisy with effusion.
3. Mediastinal adenitis.
4. Cardiac enlargement.
5. Empyema.
6. Pericardial effusion.
7. Lobar pneumonia.
8. Diffuse mottling.
9. Plastic exudate.
10. Mediastinal empyema.

Mode of Onset.—Hemorrhagic pneumonitis usually began coincidently with, or soon after, the incidence of a secondary rise in temperature,* occurring from one to five days after the patient had run what was apparently a typical influenza course. Less frequently it appeared on the fourth or fifth day after the initial onset of influenza, where the temperature curve was atypical, in that the characteristic fall did not occur. In a few instances, it was detected the day after the patient went to bed.

Characteristic Roentgen Ray Appearance.—In the earliest stage demonstrable by the roentgenogram hemorrhagic pneumonitis is recognized as a faint filmy haze opposite the level of the lower angle of the scapula. The mesial portion of haze is partially obscured by the outer portion of the normal hilum shadow. This hazy area enlarges in all directions and frequently it is observed that the adjacent portions of the upper and lower lobe are involved simultaneously. The process may advance so rapidly as to include the greater portion of all lobes in the same side of the chest within forty-eight hours. In fulminating cases, all five lobes may become blood-logged and death ensue within forty-eight hours. Hemorrhagic pneumonitis invariably began as a unilateral process, and in 82 per cent of our cases the left lung was primarily involved. It was never seen to begin in any peripheral portion of a lobe, but invariably appeared in the region of the lung roots. It was also noted that the involvement never began simultaneously in two or more widely separated areas, but it was found to spread from the original site.

* This observation was noted early in the epidemic by Lieut. J. Harkavy and personally communicated to me. This enabled us to detect a larger number of early cases than otherwise would have been possible.

Later it may develop around the roots of a lobe on the opposite side. The peripheral portions were the last to fill with blood. The true apex and the lower borders of the lower lobes were never involved. We discovered this characteristic absence of apical costophrenic involvement early in the epidemic and requested a check by autopsy. The autopsy confirmed this, so that we were enabled to utilize the sign in detecting pleuritic involvement. In other words, we found that in every case where the roentgenogram showed a haziness or a total density over the apex or costophrenic angle, it was indicative of a pleuritic complication or lobar pneumonia. In the vast majority of cases we found pleural effusion responsible.

Course.—The hemorrhage showed a tendency to disappear within three days where the area of involvement did not reach a greater diameter than a silver dollar. In moderately advanced cases, e.g., where the invasion was arrested when the involvement included no more than the lower proximal half of the upper left lobe and the adjacent proximal portion of the lower left lobe, the condition would slowly but progressively fade away, usually disappearing by the twelfth day unless complicated by some other intrathoracic condition. If in such a case there had been a progressive clearing demonstrated over a period of several days followed by an interruption, a complication usually appeared soon thereafter, the most frequent one being a pleural effusion. This often changed into empyema.

During the height of the epidemic the cases which showed extensive involvement of all five lobes usually proved fatal regardless of whether the involvement developed slowly or rapidly. Later in the epidemic, the virulence diminished and the percentage of fatalities in extensive involvements became conspicuously less. In some cases the process of absorption of the hemorrhage was noted in one lobe while a complication would develop in the region of another lobe.

Prognosis.—Soon after these daily roentgen ray observations were instituted it was found that the cases presented certain definite characteristics by which a prognosis could be offered with much accuracy. The second or third film usually sufficed to base our predictions on. Our prognosis was made utterly regardless of the clinical data. We based it upon the rate, direction and extent of the spread, interpreted in the experience furnished by the earlier cases.

The rapidity with which the hemorrhage spread to include the lobes opposite the original hemorrhage bore a direct relation to the gravity of the case. We did not observe a fatal case in which the hemorrhage remained a unilateral condition, even though all lobes on the affected side became extensively involved.

Ordinarily if the patient survived seven days after the onset of the hemorrhagic pneumonitis, the prognosis was favorable. However, the convalescence in many cases was interrupted by one or more of the previously enumerated intrathoracic complications. Empyema was the most frequent to occur after the seventh day in hemorrhagic pneumonitis.

In our series, where the roentgen ray observations were possible early in the course of the disease, we erred in two cases where a grave prognosis had been rendered. In one, all five lobes were involved and a bilateral empyema developed subsequently. This case was interesting in that an entirely different organism was recovered from the right pleura than from the left. In the other case, the convalescence was complicated and prolonged.

Theory of Invasion.—The serial radiographic studies upon the trachea, bronchi, bronchioles, alveoli and their capillaries, interpreted in the light of the autopsy findings, support the conception that the causative organism, whatever it be, gains access through the respiratory tract. It lodges and proliferates in the lower portion of the trachea or in a main bronchus, whence the organisms are distributed by contiguity, reaching first the bronchi and

alveoli in the immediate vicinity. These individual colonies elaborate the toxin which produces local destructive change in the cells lining the bronchi, the alveoli, and also the capillary walls, the result being a frank pernicious hemorrhage. The spread is perhaps augmented by the flow or inhalation of the infected bloody exudate into other portions of the respiratory tract. The process seems to develop by spread in contiguity from the original focus in the main bronchus to the alveoli.

The serial radiographs proved that the hemorrhage invariably commenced in the central portion of a lobe nearest the hilum. Later it spread in all directions simultaneously. It is plausible to assume that when the hemorrhage becomes extensive enough all approaches to the peripheral portions of the lobe are likely to be blocked off by the presence of the rapidly accumulated blood in the distributing bronchi. If this is true, the air circulation is retarded and the organisms cannot be transported either by air or by the flow of exuded blood into the more distant alveoli. Autopsy consistently confirmed the conspicuous absence of hemorrhagic pneumonitis in the true apex and in the costophrenic borders of the lower lobes. It was also noted that the alveoli situated nearest the pleura are relatively free from hemorrhage.

This absence of hemorrhage at the apex and in the costophrenic borders, together with the delayed involvement of the peripheral portions of the lobes, strengthens the theory that the hemorrhage is due to the toxins elaborated locally. It is also obvious that the hemorrhage cannot be explained on the assumption of a state of hypostatic congestion because the autopsy findings failed to confirm hypostasis in the most dependent portions of the lower lobes. Thus it is obvious that the condition is in no way a septicemia.

We found it advisable to divide our 470 cases into the following groups:

(*a*) Hemorrhagic pneumonitis uncomplicated. These presented the typical hazy spreading shadow produced by the increased condensation. No discrete mottling was present, nor was there any conspicuous enlargement of the mediastinal glands. No pleuritic complications were present.

(*b*) Hemorrhagic pneumonitis associated with a conspicuous enlargement of the mediastinal glands, but without discrete mottling.

(*c*) Hemorrhagic pneumonitis associated with discrete mottling, but without conspicuous enlargement of the mediastinal glands.

(*d*) Hemorrhagic pneumonitis associated with conspicuous enlargement of the mediastinal glands and with a definite discrete mottling over the pulmonary area.

(*e*) Hemorrhagic pneumonitis complicated by some form of pleural involvement, pericardial involvement and mediastinal empyema.

(*f*) Adenitis unassociated with hemorrhagic pneumonitis, discrete mottling, or any other form of pulmonary or pleural pathology discernible by roentgen ray.

(*g*) Adenitis and fibrosis unassociated with other intrathoracic pathology discernible by roentgen ray.

(*h*) Adenitis without hemorrhagic pneumonitis or discrete mottling but associated with some other intrathoracic pathology.

(*i*) Discrete mottling of the pulmonary area uncomplicated by hemorrhagic pneumonitis, enlargement of the mediastinal glands, or any other intrathoracic pathology discernible by roentgen ray.

(*j*) Discrete mottling associated with conspicuous enlargement of the mediastinal glands unassociated with any other intrathoracic pathology discernible by roentgen ray.

(*k*) Mottling unassociated with hemorrhagic pneumonitis and enlargement of the mediastinal glands, but associated with some other intrathoracic pathology.

(*l*) Hemorrhagic pneumonitis associated with pulmonary tuberculosis.

(*m*) Hemorrhagic pneumonitis associated with lobar pneumonia.

(*n*) Lobar pneumonia uncomplicated by hemorrhagic pneumonitis.

(*o*) Cases in which there was definite clinical evidence of pulmonary pathology but in which the serial roentgenographs failed to confirm the presence of a pulmonary lesion.

Roentgen Ray No. 5622. Group (*e*). Case illustrating hemorrhagic pneumonitis of all lobes associated with pleural effusion (bilateral). This was one of the early cases which formed the basis for the investigation.

FIG. 1. Made in autopsy room. Note homogeneous density in all 3 lobes on right and both on left. Note relative clearness of both apices. The costophrenic angles are obscured by what proved to be fluid. Compare this with Fig. 2 made of thoracic viscera after removal in toto

FIG. 2. The true apices are clear. The costophrenic portions of the lower lobes are relatively clear. All five lobes present a homogeneous density, which is not of such a high degree as is characteristic of lobar pneumonia.

Naturally the cases presenting a discrete mottling offered the greatest difficulty in interpretation, for we did not have preliminary plates by which an estimate might have been made of the previously existing chronic lesions; such as peribronchial adenitis, chronic parenchymatous, tubercular changes, etc. However, we were soon enabled to identify the mottling by autopsy. It was found to be due to discrete interstitial lesions, commonly held to be streptococcic in origin. In our cases the sum total of mottled types was so small as to be conspicuous.

The total number of patients studied roentgenographically was 470. Of these 82 per cent, or 386, presented hemorrhagic pneumonitis complicated or uncomplicated by one or more of the intrathoracic conditions already noted. Of the remaining eighty-four patients, thirty-three failed to show any lung pathology by the roentgenogram, although clinically there was evidence of so-called bronchopneumonia, seven were Group (*g*) (mediastinal adenitis), thirteen were Group (*i*) (discrete mottling uncomplicated); the remaining thirty-one could not be classified, as the presence of fluid completely obscured the original pathology.

Of the cases which came under roentgen ray observation early enough, the hemorrhagic process was found to appear primarily in the left lung in 82 per cent. This is a striking fact, but no less remarkable than the observation that in our ninety-one cases in which there was unmistakable evidence, the initial invasion appeared in the lower left lobe eighty-five times to six in the upper left lobe.

Group (*a*) includes a few cases where autopsy revealed a small amount of pleural fluid, which roentgenographically was not present twenty-four hours before death. Presumably this developed as a terminal process. The importance of serial roentgenograms in influenza has been amply proven in this clinic, chiefly in detecting and iden-

Roentgen Ray No. 5770 Group (*a*)

FIG. 1. The initial film reveals the presence of hemorrhagic pneumonitis in the adjacent portions of the upper and lower left lobes and also in the adjacent portions of the lower and middle right lobes. Note that the density is most intense at the hilum and fades out toward the periphery. Note the clearness of the costophrenic angles on the right and left sides.

FIG. 2. Compare with Fig. 1 and note the extent of spread in 48 hours.

FIG. 3. The patient was too ill to hold his breath and died within twenty-four hours after this examination.

tifying pulmonary complications in the early stages.

We had no deaths from Group (*f*) or (*g*) and so far we have not seen a single instance of fatal influenza unassociated with an intrathoracic complication.

Anticipating possible criticism of this summary on the ground that the clinical, roentgen ray and laboratory findings have not been presented in concerted form, it may be stated that the clinical, roentgen ray and postmortem findings have coincided to a remarkable degree. This will be substantiated by the full report which is under preparation for the Surgeon General and for the medical history of the war.

These roentgenographic studies were stimulated by the extraordinary autopsy findings in the early cases. Authorization was promptly obtained from the Commanding Officer, Colonel E. R. Schreiner, who with Chief of the Laboratory Service, Lt. Col. Nichols, and the Chief of the Medical Service, Major B. M. Randolph, enabled us to bring this to a successful conclusion. We are especially indebted to Captain

Roentgen Ray No. 5765. Group (*e*). A fatal case.

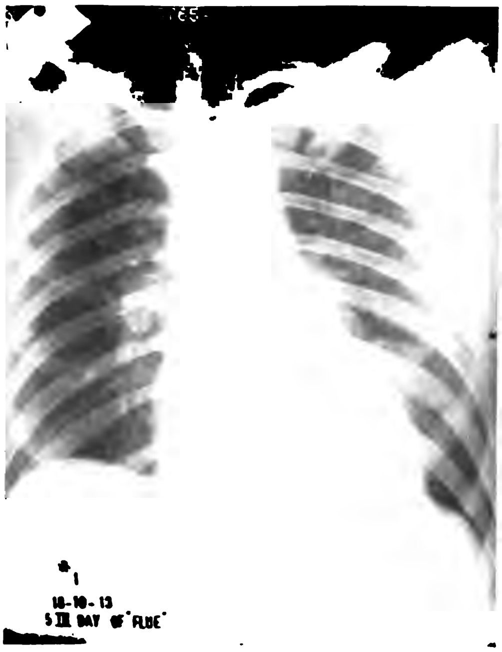

FIG. 1. Shows an early appearance of hemorrhagic pneumonitis in lower left lobe. Note area of increased density projecting from hilum. Compare with Fig. 2, taken twenty-four hours later, and note great increase on 18-10-14. Note the clearness of the apices and the costophrenic angles.

FIG. 2.

FIG. 3. On 18-10-16 shows extensive involvement of lower and middle right lobes, lower portion of upper right and adjacent portions of upper and lower left lobes. The patient was too ill to hold his breath but Fig. 3 illustrates clearness of costophrenic angles and true apex. The patient died twenty-four hours after Fig. 3 was taken.

M. W. Lyon, Lt. J. Harkavy and Lt. Adolphus Rood for their hearty cooperation. We cannot close without expressing our thanks to each and every member of the Roentgen Ray Section, all of whom volunteered to serve in the infected wards and who unsolicited cancelled their engagements that they might devote day and night to the investigation. Lt. Jamie C. Thompson was most successful in organizing the bedside squads and Lt. J. H. Hirsh was equally untiring in furthering this work.

To Major H. E. Ashbury, Roentgenologist, Army Medical School, we are indebted for his invaluable aid in placing at our disposal a sufficient number of roentgen ray technicians to form five bedside squads. The prompt cooperation of Lt. Col. George C. Johnston, Chief of the X-Ray Division of the Surgeon General's Office, enabled us to secure the necessary apparatus in the emergency.

Roentgen Ray No. 5629. Group (e). Demonstrating an extensive involvement by hemorrhagic pneumonitis which developed double empyema with recovery.

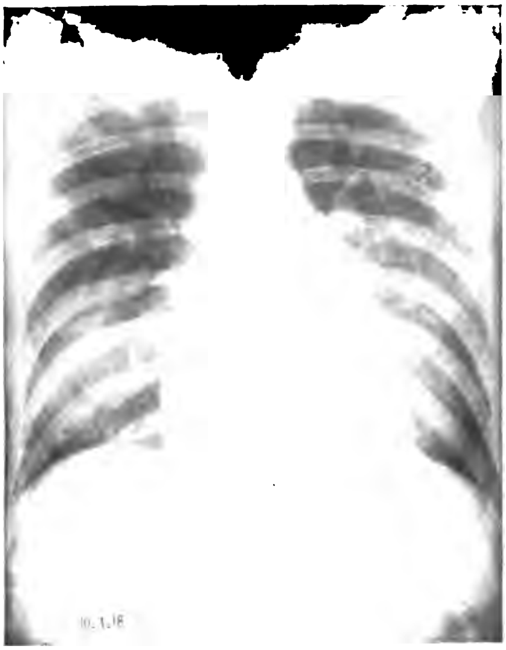

FIG. 1. Extensive hemorrhagic pneumonitis in lower right lobe, lower left lobe, and adjacent portions of upper left lobe.

FIG. 2. Compare with Fig. 1 and note extent of spread in twenty-four hours. Both costophrenic angles remain clear.

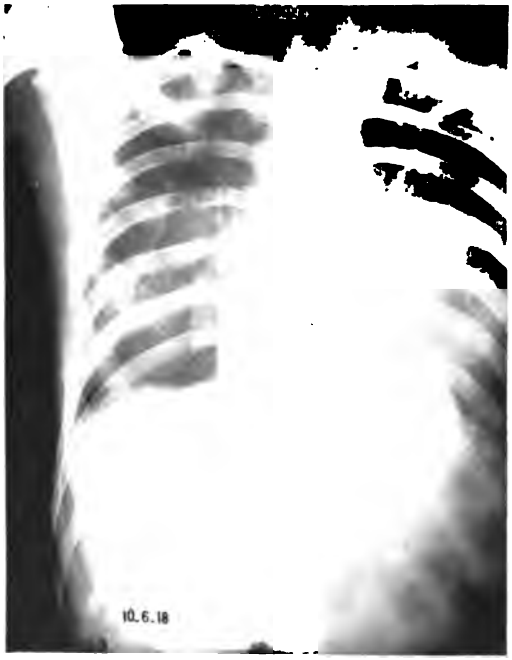

FIG. 3. The right and left chests show great improvement since No. 2.

FIG. 4. Compare with Figs. 2 and 3. The hemorrhagic pneumonitis has again spread in left chest and density has increased in right chest.

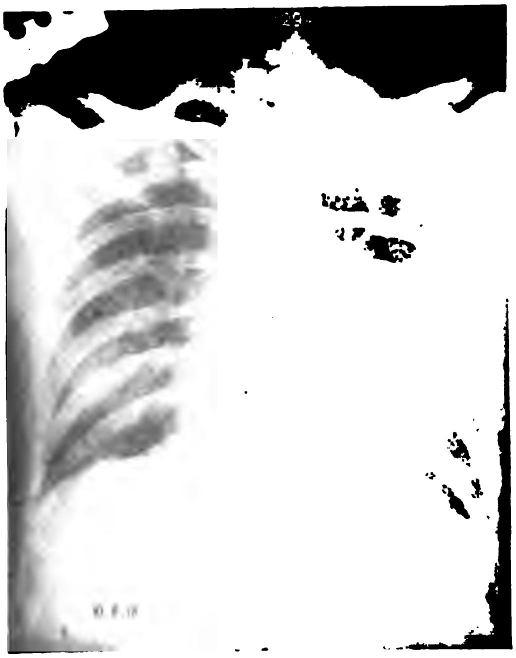

FIG. 5. Interlobar pleuritis has developed between upper and middle right lobes indicated by arrow. (Compare this with Figs. 6 and 7 for confirmation.) Lung tissue in both chests appears more mottled than in any of preceding films. Left costophrenic angle is cloudy.

FIG. 6. Very little change since Fig. 5.

FIG. 7. Very little change.

FIG. 9. Very little change since No. 7.

FIG. 11. Practically no change since Fig. 9.

FIG. 12. Left chest is more hazy, including costophrenic angle, than in Fig. 11. Right chest shows pleural effusion. Interlobar pleuritis is conspicuous.

FIG. 15. The right chest remains hazy. Density of the left chest is more marked than in the preceding plate. Fluid is present.

FIG. 16. No appreciable change as compared with Fig. 15.

Fig. 21. Left chest remains dense from second rib to diaphragm.

Fig. 22. Lower right chest has developed an increased density since Fig. 21.

Fig. 23. No change as compared with Fig. 22.

Fig. 24. No change as compared with Fig. 23. Empyema has developed in the lower left chest. Two days after this film was made 1000 c.c. of pus was aspirated.

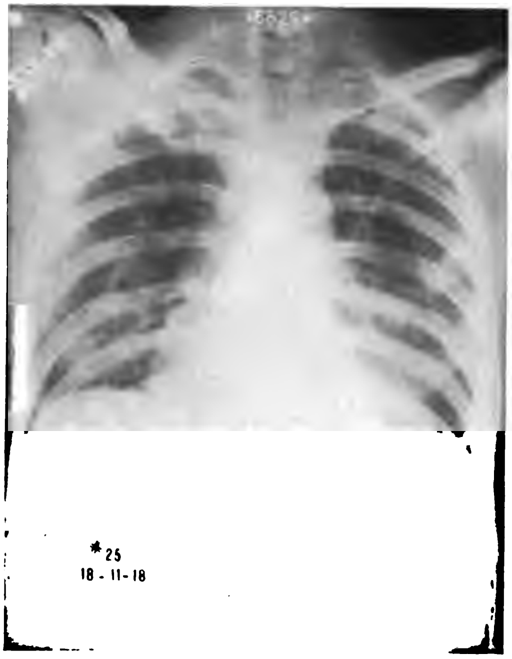

FIG. 25. This film was made nineteen days after Fig. 24. During this time, the empyema was drained. The interlobar pleuritis has almost entirely disappeared and both chests are much clearer.

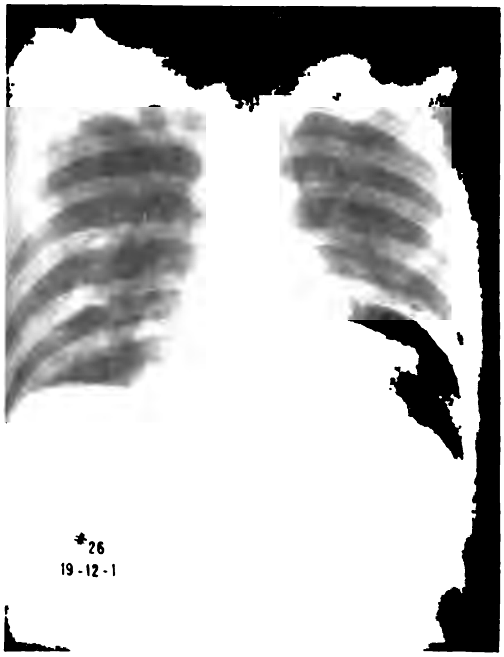

FIG. 26. Continued improvement.

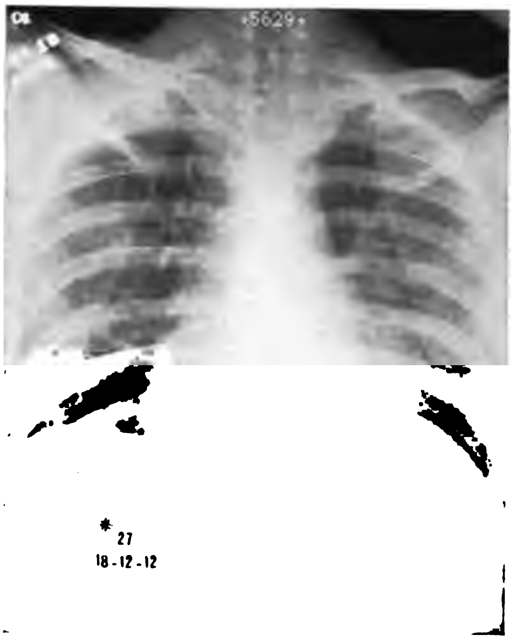

FIG. 27. Both chests are clearing up.

FIG. 28. The right chest is almost clear. The arrow (R) indicates a faint trace of the interlobar pleuritis. Arrow (L) indicates an adhesion developed by the empyema.

NOTE: This case was referred to in the paper as one in which an error in prognosis was made. On the date of Fig. 8, the indications were that it would prove fatal.

Roentgen Ray No. 6882. Group (*e*). This series presents a case in which the lungs remained uninvolved for seven days and then developed hemorrhagic pneumonitis, complicated by pleural effusion, interlobar pleuritis, and empyema, which was confirmed by autopsy.

FIG. 1. No evidence of any pulmonary involvement.

FIG. 2. No evidence of any pulmonary involvement.

FIG. 3. No evidence of any pulmonary involvement. Shows normal lungs.

FIG. 4. Shows a beginning interlobar pleuritis betwee upper and middle lobes on right, associated with slight haziness of middle right lobe.

FIG. 5. Four days later, shows extensive involvement of all three lobes on right, costophrenic angle, and apex obscured by fluid. Interlobar pleuritis well developed, indicated by arrow. Lower left lobe shows involvement to less degree than on right. Heart silhouette greatly enlarged and contour changed compared with Fig. 4.

FIG. 6. The right chest is slightly clearer than in Fig. 5 500 c.c. of fluid have been removed since Fig. 5 was made. Lower left lobe is more extensively involved. The patient was too ill for further examination and died twenty-four hours after this film was made.

Roentgen Ray No. 6859. Group (*d*). This series of films illustrates a case of hemorrhagic pneumonitis associated with adenitis and mottling. It also presents the complication empyema of the mediastinum and empyema of the lower left pleura.

FIG. 1. Shows hemorrhagic pneumonitis of lower right, diffuse mottling of upper and middle right lobes, diffuse mottling of lower and slight mottling of upper left lobe. Costophrenic angle on left is obscured. Mediastinal glands are enlarged. Arrow points to area of abnormal density in mediastinum, which subsequent films prove was a developing mediastinal abscess.

FIG. 2. The arrow points to the large mediastinal abscess. The cross indicates the presence of empyema of the lower left chest. The heart silhouette is greatly enlarged, suggesting pericardial effusion.

FIG. 3. Compare with Fig. 1 and note the discrete mottling which has developed since that date. The mediastinal empyema is unchanged in appearance. The empyema is more extensive than in Fig. 2. Compare this with Fig. 4, made after aspiration of the mediastinum and of the lower left chest.

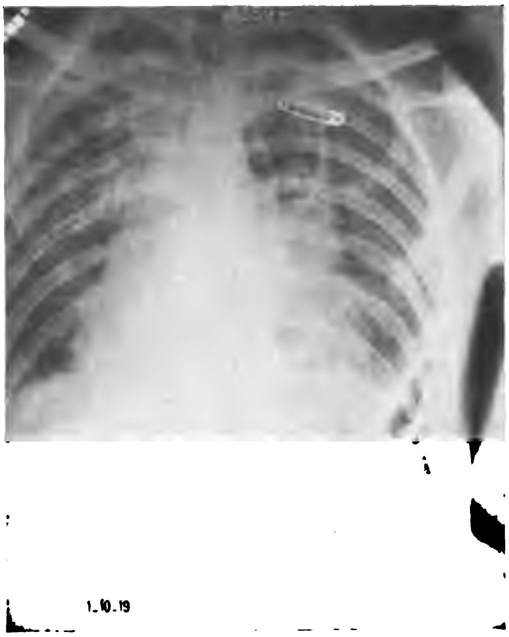

FIG. 4. The safety pin holds the drainage tube in the left mediastinum. The empyema has been completely evacuated from the lower left chest. The lungs are much clearer than in preceding figures.

FIG. 5. The lungs are clearing rapidly, adequate draining is being maintained and the chest presents a greatly improved appearance.

FIG. 6. The mediastinum is practically clear. Note the drainage tube with the wire insert. The safety pin holds a large caliber drainage tube in the lower left chest.

INFLUENZA AND BRONCHOPNEUMONIA

A STUDY OF THE EPIDEMIC FROM A ROENTGENOLOGICAL POINT OF VIEW

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THE opportunity to study influenza from a roentgenological point of view has been exceptional. The conditions under which the study was undertaken were most favorable on account of the interest of the Commanding Officer, the cooperation of the Staff and Ward Surgeons, the absolute control of the patients, the close relations with the Pathological and Bacteriological Department, and the reliability of the staff of the *X*-Ray Department.

Introduction.—This study was undertaken in a modern hospital thoroughly equipped with a really practical system for taking care of patients and their records. The roentgenological examination of the patients was possible because of a U. S. Army bedside roentgen ray apparatus which enabled the Department, as a matter of routine, to examine the patients with very little disturbance, from the beginning of the attack until recovery or until the patient succumbed to complications. The very earliest cases were roentgenographed in the Department in the upright position and later in bed in the prone and upright positions. Those cases that had a final examination were, of course, taken after the patient had been returned to duty, and were taken in the Department in the upright position again. This study therefore covers a number of cases from the earliest onset of influenza to the full development of the disease and the later period from the time when the patient developed a bronchopneumonia to recovery or to autopsy, every case coming to autopsy having a post-mortem roentgenological examination. Consequently the three types of pulmonary changes to be studied are those produced by influenza, bronchitis, pneumonia and other associated processes. As this institution is primarily for tuberculosis cases, the after effects of influenza and pneumonia on the tuberculous processes had to be borne in mind.

Review of the Literature.—As far as could be determined, this shows no reference to a study having been made of the epidemic from a roentgenological standpoint. A clinical and pathological study of previous epidemics, last spring and early fall of this year, in military camps in the United States and at naval hospitals abroad gives evidence of considerable value for the present study. I should especially like to call attention to the abstracts of foreign literature on influenza compiled by the British Medical Research Committee concerning the pathology of the disease. It was found that the same short period of incubation, the rapid and sudden onset and the general trend of symptoms were the same. It was found that it was a common occurrence to have a remission the second or third day; that after this a coryza occurred with bronchial cough; that approximately one week later the patient became normal; also that bronchopneumonias developed most frequently after the second remission. The occurrence of bronchopneumonia in these epidemics was approximately 5 to 10 per cent with a mortality of approximately 60 to 70 per cent. Empyema or purulent processes occurred very seldom, but in the terminal stages of the disease a sero-fibrinous effusion into the pleural cavity, which was

* Authority to publish granted by the Board of Publication, Surgeon General's Office, Washington, D. C.

usually unilateral and most often on the right, occurred quite frequently.

What is of specific interest to this particular study is that clinically the process of bronchopneumonia appeared as a continuation of the bronchitis which was present in a large percentage of cases, and that in cases of progressive or extensive involvement, the patient rarely recovered.

Consolidation occurred most often in the right lower lobe just medial to the inferior angle of the scapula, next affecting the left lower lobe, then the right upper and middle lobes, and finally the left upper lobe.

MacCullum, reporting on the pathology of the epidemic *Streptoccocal Bronchopneumonia in the Army Camps*, gives a very clear description of these processes. This must be thoroughly understood to appreciate the changes brought about as seen on a roentgenogram. He states that the most characteristic lesions appeared; that at necropsy there was found most intense congestion of the whole respiratory tract; a nodular consolidation could be felt throughout but especially in the posterior parts of the lungs. On section the bronchi contained a gray purulent exudate. They were markedly dilated toward the periphery. The mucosa was a deep, purplish gray. All showed thickening of the walls and the terminal bronchioles were especially thickened so that with the adjacent alveoli they projected in cross section in the form of small firm nodules. Such dense peribronchial nodules were nearly always surrounded by hemorrhage. Often in these very fresh cases there were occasionally small areas of more homogeneous consolidation. Microscopically the lumen was found to be filled with an inflammatory exudate of leucocytes, blood and bacteria and in the infiltration and thickening of the walls of the bronchioles were mononuclear wandering cells. Great hyperemia and edema of the bronchial walls was seen accompanied by a less evident new formation of connective tissue cells. The adjacent alveoli, so far as they were not filled with red blood corpuscles, were compacted with mononuclear cells and dense fibrin. The alveolar walls were infiltrated with mononuclear cells and were widened.

Keegen, reporting on the prevailing pandemic of influenza, states that on autopsy these cases showed a massive bronchopneumonia simulating lobar pneumonia, from which a large quantity of blood exudated from the cut surfaces. He also states that the heart in only one case out of thirty-five was acutely dilated.

The British Committee abstract states that: "In the initial stage of the affection of the lungs, namely, when only small foci without any great reaction in the immediate neighborhood were observed, the most striking findings were small, bean-sized hemorrhages projecting into the lung tissue. As a next step there followed a firmer infiltration of the parenchyma, the nodules sitting subpleurally and raising the pleura in consequence. A whole scale of intermediate formations lay between these small nodules and large hemorrhagic tuberous infiltrations; all possible gradations were observed from simple blood extravasations into the lung tissue, still containing air, to firm, almost dry, infarct-like hemorrhages of a bluish-black tinge. These extensive infiltrations were of the same shape as the usual pulmonary hemorrhagic infarcts, namely, they had the form of a wedge with its base resting on the pleura, thus clearly indicating an intimate relationship with the vascular system of the lungs.

"The second stage was characterized by exudative pneumonic processes combined with hemorrhages. There may be a true croupous hepatization of lobular, or even lobar, extent, both red and gray. These pneumonic infiltrations usually embraced in their center circumscribed hemorrhages.

"The bronchi were filled with pus already in the first stage, the smaller branches containing thin fluid, though at times dried-up exudates formed firm plugs occluding the lumen of the bronchioles.

"The pleura participated in the process. The first signs consisted in punctiform hemorrhages, or ecchymoses; serous exudations followed next, and, as often as not, empyemas completed the picture. As a rule, one side only was affected. Pericarditis was a natural consequence of pleuritis. There were no gross changes in the heart save for some thickening of the arteries of the lung hilum.

"The larynx and the upper third of the trachea showed no involvement in the process. The lower portion, however, was the seat of an intense mucopurulent exudation, which in many cases assumed a fibrinous character, with the consequent formation of extensive pseudomembranes in the lower trachea and down into the bronchi. Sometimes edema of the epiglottis was observed. Marked lymphatic changes were also observed with enlargement of the cervical and axillary glands.

"The foci of inflammation in the lungs showed a leukocytic infiltration around the alveoli, bronchi, and the walls of small arteries. It did not involve the whole vessels, which were dotted with isolated spots of infiltration. There were also hemorrhages into the heart valves, with a consequent displacement of the fibers and damage to the endothelium; thus no definite endocarditis, but lesions, which facilitated the development of a secondary mycotic endocarditis."

It is evident from the review of the literature that limited information from a pathological point of view was obtained as to the direct results on the parenchyma tissue due to influenza alone. The changes usually described invariably mean changes seen in bronchitis with development of a broncho- or lobar pneumonia and after results. Although the study of clinical and pathological reports of past epidemics is interesting, there appears to be a distinct difference as compared with the last epidemic and these differences as they affect the roentgenological diagnosis will be pointed out later.

As far as the causative factors are concerned, there apparently is still discussion; but in this investigation it is assumed that the bronchopneumonias were due to the pneumococcus and the changes expected would be no different from bronchopneumonias seen roentgenologically under ordinary conditions.

The Present Problem.—It became apparent that roentgenological examination would only be of value in the very earliest cases of beginning bronchopneumonia and also in determining the extension of the process from one lung to the other or from one lobe to another. The study, therefore, was undertaken with these points in view, namely: (1) What the appearance of influenza was; what changes were brought about, whether consistent, and how these changes progressed; as well as what the associated changes were in adjacent tissues or organs. (2) How early, if possible, could a bronchopneumonia be detected; what its progress was; what part of the lung was most actively affected; associated tissue changes, cardiac changes, diaphragm changes; and whether progressive improvement was noticed in the lung not affected by a pneumonic process but previously affected by influenza. (3) Whether the marked bronchial changes noted due to influenza would determine the type of pneumonia, that is, whether the bronchial changes would be sufficiently early to show when the bronchioles became affected and whether these changes would determine the changes characteristic of a broncho- or a lobar pneumonia.

Class of Cases Studied.—This consisted of corps men, patients, and staff. From September 24 to November 4, 260 cases of influenza occurred. Of these 118 were corps men, 37 Students' Army Training Corps men, 67 patients, 17 nurses, 13 medical officers and 8 miscellaneous. Of these 260 cases, 91 cases were studied roentgenologically. In the 260 cases there occurred 66 cases of pneumonia. Of these 91 cases, there were 52 cases of bronchopneumonia and 4 cases of probable bronchopneumonia. These occurred among the

following classes: Of the 55 corps men, 36 had bronchopneumonia; 2 had probable bronchopneumonia; one had probable lobar pneumonia; and the remaining 16 had influenza and congestion.

Of the 8 nurses studied, 6 developed bronchopneumonia; 2 recovered as influenza and congestion.

Eleven medical officers were examined and of these, 2 developed bronchopneumonia; 2 had questionable bronchopneumonia; 1 had a probable lobar pneumonia; 6 had congestion and influenza.

Of the 15 tuberculous patients, 7 had bronchopneumonia; 3 had pneumonia (type undetermined) and one had a probable bronchopneumonia; 4 continued as influenza with congestion.

The cases studied depended largely on the clinical signs and symptoms presented whether suitable for serial roentgenological study, questionable clinical diagnosis, or whether atypical in type. It will be seen from these numbers that 28 cases of influenza and congestion were studied. The rest actually became cases for the study of pneumonic processes. The examinations varied in number from one to ten. In the case of influenzas and congestions, these examinations often were taken every day while the bronchial changes progressed, until the patient recovered, or until a pneumonic process developed, examination being less frequent after a definite diagnosis of the process was made. In the case of a pneumonia being diagnosed on first examination, repeated examinations were then made to determine the progress of the disease until the final stage had been reached. In only one case did an empyema develop. Several cases developed fluid in the chest, probably of pleural origin, and most rapidly in the serious cases that finally came to autopsy.

A full report was made each day after original description of the roentgenogram, and the clinical evidence was carefully considered and discussed so that both the medical officer, staff and student officers and department staff could get the most value from these discussions. Very ideal conditions, therefore, prevailed for the study of influenza and its complications and there was extremely close cooperation between the clinical and roentgenological staff.

Influenza — Roentgenographic Appearance.—On examination of the roentgenograms there is seen to be a general increase of density throughout the lungs. This density may be described as being of a hazy or smoky nature which decreases the contrast between the normal lung transparency and the bronchial tree outline. This generalized density is somewhat greater from apex to the base, inner half, and especially adjacent to the mediastinal border, thus obscuring to some extent the mediastinum and cardiac outline. The most marked changes are seen in the bronchial structures themselves. A greater number of vessels are seen than is usual in any other disease. They are more definite although diffuse in outline. This peribronchial thickening, however, is seen most markedly around the hilus, extending outward in "sunburst" type and rapidly diminishing in size from the hilus to about the outer one-third of the lung. The peribronchial thickening extends upward parallel to the mediastinum and helps to obscure the mediastinal outline. The greatest thickening and greatest diffuse bronchial density is seen at the base, extending downward from the hilus, reaching the diaphragm outline and extending to just beyond the mid-clavicular line. This is more marked on the right than on the left, largely because the left is obscured by the heart, but probably also because the larger number of cases of marked bronchitis or bronchopneumonia occurred at the right base, and partly because of the anatomical difference between the right and left bronchial structures. The diffuse density of the bronchial outline, although becoming most marked in some cases, never showed a "pussy-willow" effect unless a bronchopneumonia was develop-

ing. The distribution of the bronchi could be fairly well traced out but the difference between the bronchi and parenchyma is most often diminished.

In cases where influenza progressed as influenza towards recovery there is a gradual diminution, first, in the hazy generalized density and then in the diffuse density of the bronchial structure. The density around the hilus, due partly to peribronchial thickening, remains considerably longer. The hilus becomes affected very early. There are an immediate enlargement of the hilus and a marked increase of density with irregular outline, so much so that in no case is there any question of the reaction of the hilus. The irregular outline is due to peribronchial thickening.

In a few cases there is definite enlargement of glands at the same time in the hilus region.

The mediastinum in some cases is somewhat increased in width and, as previously described, the outline is shown to be increased in density.

The diaphragm is, if anything, more dome-shaped; that is, the convexity is increased and the cardio-diaphragmatic angles become more acute. Also there is some obliteration of the costo-diaphragmatic sinuses.

The heart shows a slight dilatation of the right auricle and, to a less extent, a slight dilatation of the pulmonic area. The heart as a whole is not enlarged.

The appearances as described are typical and consistent—so much so that a diagnosis of influenza and congestion could be made in almost every case, and a diagnosis of influenza and congestion was made in several cases before there were any clinical signs to warrant such a diagnosis; and in two cases of tuberculosis a diagnosis of influenza and congestion was made a week after onset of the disease and when tuberculosis was the only clinical diagnosis. In a few cases the changes were very light and these invariably were cases that led to a speedy recovery. Unilateral congestion was seen in a few cases and these invariably recovered within a few days. In one case, an influenza suspect, a diagnosis of bronchitis was made and later clinically verified; and in another, a diagnosis of transitory congestion was made and within forty-eight hours verified. This proved to be a case of serum reaction. These cases are quoted to emphasize the specific value of the roentgenological changes in influenza.

The appearances, therefore, of the lungs and bronchi show a very early and marked congestion of the parenchyma and bronchial tissues. It is an active congestion as the bases in none of the cases show a greater congestion than the middle or upper portions. It also shows that the lower bronchial structures and the bronchi of large diameter are earlier and more markedly affected than the smaller and terminal branches. It shows also a marked lymphatic and glandular congestion and reaction as demonstrated by changes in the hilus area and a diminution in pulmonary function as evidenced by the height and shape of the diaphragm. The cardiac changes also bear out the early congestion of the lungs. The changes in the bronchi in early bronchopneumonias will be taken up under the study of bronchopneumonias.

Bronchopneumonia, the Appearance of.—As previously stated, there were 91 cases of influenza, and of this number 52 were cases of bronchopneumonia and 4 cases of probable bronchopneumonia. Of the 4 probable bronchopneumonias, 2 resembled true lobar pneumonia. In the most typical cases, those developing gradually, the first changes seen, after those described under influenza, are apparently bronchial in nature. There is a greater irregular diffuse peribronchial thickening so that the individual outline of the bronchi can be made out with difficulty. Then there occur small, more or less localized areas, most visible in the middle of the lung, 6 to 8 cm. distant from the hilus, but in very early cases occurring nearer

the hilus and most often in the lower part of the lung. These localized areas superimposed and adjacent to the bronchial outline resemble somewhat the "pussy-willow" stage in the budding of the willow branch seen in spring.

The next distinct stage is a spreading out of these areas to a confluent, more or less localized area, varying in size from approximately 3 to 6 cm. in diameter. If this occurs in the full pulmonary field, the localized congestion appears light and hazy, not unlike a "powder-puff" in appearance, with an irregular, soft, diffuse outline. In a few cases resolution begins in this stage; but in the majority of cases the process progresses, the density increasing and detailed structures becoming obscured. The bronchial outline is no longer visible and pulmonary changes become more extensive and definite. In short, a pseudo-lobar pneumonic appearance is seen. If this occurs at the base, the heart and diaphragm outlines are obscured, the sinuses are obliterated and the density from apex to base becomes gradually greater. It frequently occurs that, after one portion of the lung has become consolidated and the process progresses, the next earliest changes are seen on the opposite side, extending outward from the hilus after primary hilus changes, in the same manner as previously described. Associated with the early bronchial changes there are marked changes in the hilus on the side where these bronchial and pulmonary changes begin. The hilus becomes more dense and more definite in outline, as well as increasing in size. In comparison there is a distinct difference in the hilus on the opposite side, if the process involves that lung. When the process becomes extensive, the hilus outline becomes obliterated.

Progressive changes in the lungs in advanced cases are of less interest. As consolidation increases, the density naturally also increases and the outlines and details of structure disappear.

In the marked changes of bilateral pneumonias where the greater portion of both lungs is affected, the bases become so dense that a differential diagnosis between an extensive edema, pleural effusion and pneumonia, as such, cannot be made.

Two associated changes occur very early in the onset of pneumonia which are of great interest and importance. Invariably as early as the changes occur in the hilus there is seen in the heart a marked and acute dilatation of the right auricle and also dilatation of the pulmonic area. In a number of cases dilatation of the aorta also occurred. In a few cases in the later stages, dilatation of the left ventricle was also seen. Reference to the tables will show the number and type of cases in which these changes were observed.

The second associated change has to do with the position and shape of the diaphragm. In the majority of cases the diaphragm on the side affected becomes more dome-shaped and its position is from one to two interspaces higher than normal. This was so marked and occurred so frequently that emphasis was made of this in the diagnosis of cases. In massive types of pneumonia the diaphragm was often lower than usual.

The changes described therefore show the bronchial congestion first with associated hilus changes; then localized congestion of the bronchioles; and lastly the congestion of the true parenchyma. The early dilatation of the heart accentuates the acute and rapid congestion of the lungs and the marked changes in the diaphragm also indicate the early impairment of respiratory function on the side affected. In a few difficult cases there was some difficulty in differentiating true bronchopneumonias from the lobar type and it was only possible to make a differential diagnosis after resolution began, as it is well known resolution in lobar pneumonias begins near the hilus and retrogresses towards the periphery, whereas in bronchopneumonias this is reversed.

What is of special significance and of aid to the clinician is the verification of

CASE 512. First Examination.

suspected bronchopneumonias based on very slight changes in breathing over localized areas with occasional râles. In a number of cases roentgenological examination showed areas of congestion as described before clinical evidence was presented. The consistency of the changes stated become also of considerable prognostic value. It is found that if these small diffuse areas of congestion occur widely distributed around the hilus of a more irregular and faint type, these cases invariably progress to massive types of pneumonia rapidly and more intensively.

It is equally true in cases where the bronchial changes are less evident and the parenchyma changes greater. The prognostic value of the changes in the lung and hilus as well as in the diaphragm are also seen during resolution. The return to normal of the right auricle and the pulmonic area after dilatation seen during the acute pulmonary changes is exceedingly slow. It was of extreme interest to consult the clinician as to the changes found from day to day and to determine the accuracy of the physical signs with the consistency of the changes as shown by the roentgenogram. The consistency of these changes and their frequency can be seen by referring to the tables.

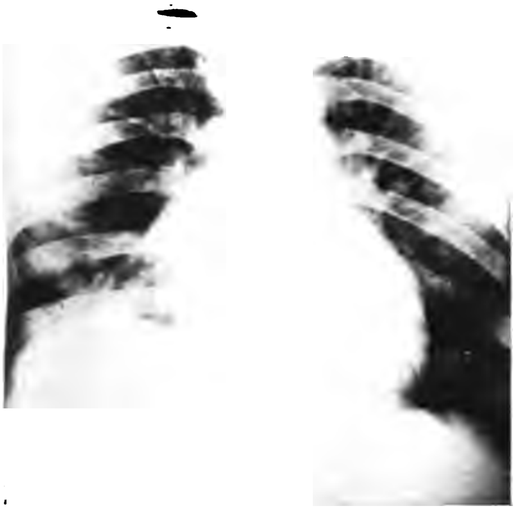
Lobar Pneumonia.—In the four cases presented in which a diagnosis of bronchopneumonia could not be made, a definite lobar type of density occurred, more or less demarcated, localized to a lobe, limited by the interlobar fissure, and with the greatest density occurring at the

CASE 512. Second Examination.

CASE 512. Third Examination.

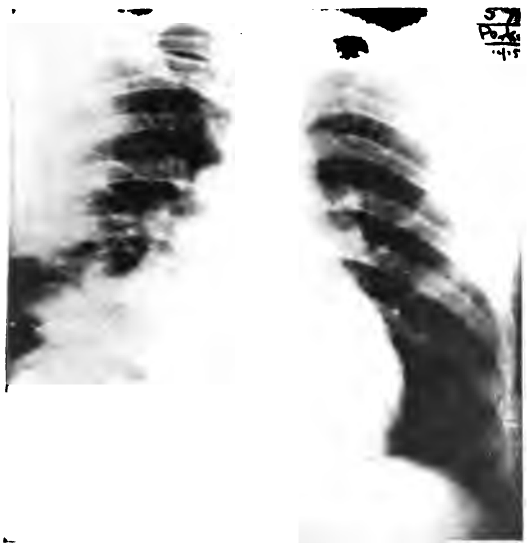
periphery and gradually less toward the hilus. In two of these cases the diagnosis of bronchopneumonia was made only after resolution had begun. In the remaining two cases the diagnosis of lobar pneumonia stood.

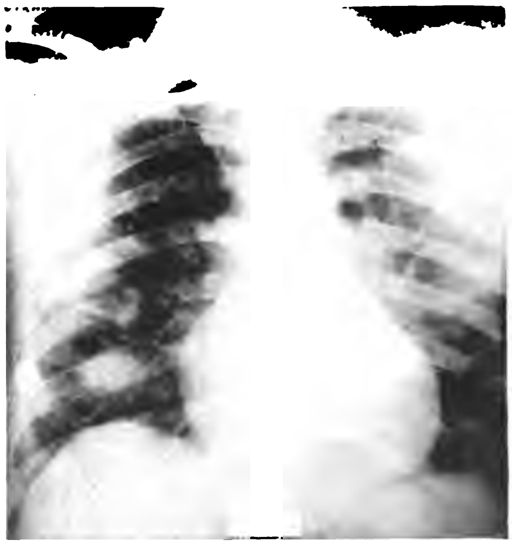
It is well to point out here the importance of an early roentgenological examination to determine the type of pneumonia, that is, to determine the bronchial changes before parenchyma changes and before these small areas of density become confluent and the congestion so great as to simulate a lobar pneumonia.


Case 540. First Examination.


Case 540, Second Examination.

Pleural Changes.—In a few cases a pleural reaction was demonstrable. This can, of course, only be demonstrated in the interlobar fissure where any congestion or thickening of the pleural surfaces can be detected, and it is largely due to the fact


Case 540. Third Examination.


Case 540. Fourth Examination.

that the position of the interlobar fissure gives depth to the pleura, and depth with congestion is necessary to give a shadow on the roentgenogram.

CASE 540. Fifth Examination.

CASE 540. Sixth Examination.

An unusual opportunity was presented, however, to demonstrate the early congestion of the pleura in influenza. A case of tuberculosis with a complete unilateral pneumothorax without adhesions became affected with influenza and was examined roentgenologically. This was a case in which a previous roentgenogram had been made before the attack of influenza so that a comparison between the roentgenograms could be made. There was a marked congestion of the pleura throughout, which on con-

CASE 430. First Examination.

CASE 489. First Examination.

secutive examinations grew greater and then gradually receded. This was associated with a congestion of the opposite lung and acted as a control in the study of the pleural congestion. Reference to the autopsy findings in the later part of this report will show how frequently pleural affections occurred.

Sequelæ.—Under this heading two conditions may be considered, mediastinal and pulmonary changes. It has been pointed out in the preceding pages what marked changes occur in the hilus and mediastinum and from the pathological abstracts quoted the changes in lymphatic tissue and glands have been significant. From observation of the cases recovering, the attention of the medical staff was called to the slow improvement and gradual changes in the lungs, and the persistency of the congestion of hilus and mediastinum. A suggestion was made, therefore, to the clinician that the presence of d'Espine's sign would be an indication of this condition and a sign of some prognostic value. This suggestion has been followed and although a complete report cannot now be made, d'Espine's sign has been found to be present in approximately fifty per cent of all cases examined. The second condition is the possibility of tuberculosis occurring after the disappearance of acute pulmonary processes.

CASE 362. First Examination.

CASE 436. First Examination.

Tuberculosis with Influenza and Bronchopneumonia.—At the outset a diagnosis of influenza or bronchopneumonia is extremely difficult to make unless the tuberculous lesion is an apical one and not of recent activity. In cases of fairly advanced tuberculosis or tuberculosis showing active processes with congestion the interpretation of a roentgenogram to differentiate these lesions from those produced by influenza or bronchopneumonia is well-nigh impossible. In the cases of tuberculosis that had roentgenograms previous to the attack of influenza a comparison, of course, can be made and in the majority of cases a diagnosis of a more acute condition is possible. In all the cases developing into a lobar form of bronchopneumonia a definite diagnosis can be made. In the cases which have led to recovery there have been observed differences in density and structural changes at the site of old tuberculous lesions, mainly apical, which suggest a field of work which will be of considerable value.

From the evidence already obtained concerning pulmonary apical changes, two conclusions may be drawn—either that there is renewed activity of an old tuberculous process due to the superadded acute infection; or that a congestion exists at the site of a tuberculous lesion which is more permanent in character than the influenza congestion and which may lead to active tuberculosis in case the patient is not placed under observation and care. A study of these cases and those coming to autopsy will be made later. It has been likewise difficult to determine the effect of the acute process on the hilus and diaphragm, as part of these changes may possibly be due to the tuberculous process. Dilatation of the right auricle and pulmonic area, however, was noted in all the cases.

Postmortem Findings.— Of the 11 cases that came to autopsy, 3 occurred among patients and 8 among corps men. The 3 tuberculosis cases developed bronchopneumonia. All three cases had postmortem examinations and the diagnosis of bronchopneumonia verified. Marked pleuritis and acute bronchitis occurred in all three. There was edema of the lungs in two cases. There was acute dilatation of the heart in two cases.

Of the 8 cases occurring among the corps men, 7 had post-mortem examination. In all eight a diagnosis of bronchopneumonia had been made and this diagnosis verified by autopsy. In 6 cases acute bronchitis was found and in 3 acute dilatation of the heart, and in 7 edema of the lungs or pleural effusion was found.

The condition of the lungs and bronchi found on roentgenological examination corresponds closely to the findings of MacCullum and Keegan and others. The protocols of the autopsies made here have omitted the position of the diaphragm, but in the majority of cases the extreme height of the position of the diaphragm was verified. The marked edema or pleural fluid corresponds to the roentgenographic density at the bases of the lungs. The extent of the pneumonic processes varies but slightly. The large amount of bronchial exudate and thickening of the bronchial walls correspond well with the roentgenographic description given in the study of influenza. Dilatation of the right auricle was very perceptible on opening the thoracic cavity and this is a distinct point of difference from previous postmortem findings but it bears out the roentgenological findings. The pleural reaction as already described was evidenced by the amount of pleural secretion and pleural fibrin organization

CASE 473. First Examination.

especially between the lobes, although not nearly as marked as occurred in the previous bronchopneumonic epidemic seen. The enlargement of glands was found in one of the ten autopsies. In short, autopsy findings verify the conditions in detail as described by roentgenological examination.

Clinical and X-ray Diagnosis Compared with Final Diagnosis.—(Includes all groups.)

1. Clinical diagnosis bronchopneumonia, with *x*-ray diagnosis agreeing and confirmed by final diagnosis 16
2. Clinical diagnosis influenza, with *x*-ray diagnosis agreeing and confirmed by final diagnosis . . 18
3. Clinical diagnosis lobar pneumonia, with *x*-ray diagnosis agreeing and confirmed by final diagnosis:
   Clinical diag.—Lobar pneumonia.
   X-ray diag.—Lobar pneumonia and fluid
   Final diag.—Lobar pneumonia and fluid . . 1

4. Clinical diagnosis bronchopneumonia; *x*-ray diagnosis influenza, confirmed by final diagnosis . 3
5. Clinical diagnosis influenza; *x*-ray diagnosis bronchopneumonia, confirmed by final diagnosis . 15
6. Clinical diagnosis influenza; *x*-ray diagnosis lobar pneumonia, confirmed by final diagnosis . 1
7. Clinical diagnosis not determined; *x*-ray diagnosis congestion, bronchitis; final diagnosis congestion, influenza 1
8. Clinical diagnosis influenza confirmed by final diagnosis; *x*-ray diagnosis negative 1
9. Clinical diagnosis bronchopneumonia confirmed by final diagnosis; *x*-ray diagnosis probable lobar pneumonia 1
10. Clinical and *x*-ray diagnosis influenza; final diagnosis bronchopneumonia 12
11. Clinical diagnosis influenza; *x*-ray diagnosis probable pulmonary tuberculosis; final diagnosis congestion, influenza, tuberculosis 1
12. Clinical diagnosis influenza; *x*-ray diagnosis fluid; final diagnosis pneumonia (probable bronchopneumonia) 1
13. Clinical diagnosis questionable; *x*-ray diagnosis positive; final diagnosis positive:
    Clinical diag.—Questionable pneumonia
    X-ray diag. bronchopneumonia, confirmed by final diagnosis 3
    X-ray diag. influenza, confirmed by final diagnosis 1
    X-ray diag. influenza; final diagnosis bronchopneumonia 1
14. *X*-ray diagnosis questionable bronchopneumonia, confirmed by final diagnosis; clinical diagnosis influenza 4
15. *X*-ray diagnosis questionable bronchopneumonia; clinical diagnosis bronchopneumonia; final diagnosis confirming 1
16. *X*-ray diagnosis questionable pneumonia; clinical diagnosis influenza; final diagnosis bronchopneumonia 1
17. *X*-ray diagnosis questionable influenza; clinical diagnosis influenza; final diagnosis influenza . . 1

Total 83

Radiological Changes (includes all groups).

Lung Density.
- Right 18: br. pn. 12; infl. 6
- Left 18: br. pn. 15; infl. 2; lobar pn. 1
- Both 33: br. pn. 27; infl. 6
- — 20
- Upper only 3: br. pn. 3
- Middle only 8: br. pn. 7; infl. 1
- Lower only 26: br. pn. 17; infl. 9
- Upper and lower 3: br. pn. 3
- Upper and middle 5: br. pn. 4; infl. 1
- Middle and lower 15: br. pn. 15
- Upper, middle and lower 8: br. pn. 6; infl. 1, lobar 1
- — 21

Congestion.
General congestion in all but 6 cases—br. pn. 2; infl. 4. (All six cases showed local congestion)
Local congestion in all but 17 cases—br. pn. 8; infl. 9 (All seventeen cases showed general congestion)
Lobular. 41: br. pn. 36; infl. 5; questionable 15; br. pn. 7; infl. 6; lobar 1
Lobar. 27: br. pn. 24; infl. 3; questionable 1; lobar
Bronchial. All but 13: br. pn. 9; infl. 3; questionable 1; lobar

Hilus Density
- Right 10: br. pn. 4; infl. 6
- Left 1: br. pn. 1
- Both 78: br. pn. 51; infl. 25; lobar 1
- Middle and lower 22: br. pn. 16; infl. 6
- Upper, middle, lower 66: br. pn. 40; infl. 25; lobar 1
- Upper and lower 1: br. pn. 1

Enlarged in every case but 4. In these four cases only slight enlargement: br. pn. 2, infl. 2.
Congested in every case but 4. Congestion slight in these four cases: br. pn. 2, infl. 2.
Outline.
- Well defined 18: br. pn. 8; infl. 10
- Fair 38: br. pn. 23; infl. 14; lobar 1
- Ill defined 34: br. pn. 28; infl. 6

Mediastinum.
Increased in density in every case.
Enlarged, broadened in all but three cases, where it was slightly enlarged: br. pn. 1; infl. 2

Diaphragm.
Dome-shaped in all but 14 cases. Of these 3 were slightly dome-shape: br. pn. 2; infl. 1
Dome-shape on rt. 2: br. pn. 1; infl. 1
Flat 9: br. 4; infl. 5
Flat 58: br. pn. 36; infl. 21; lobar 1.
Flat on the left only, 2: br. pn. 1; infl. 1.
Irregular 13: br. pn. 10; infl. 3.

Heart. Rt. auricle dilated in all but 23 cases, of which 2 were negative (infl. 2); 1 showed moderate enlargement (br. pn. 1); 19 showed slight enlargement (br. pn. 13; infl. 6) and 1 was questionable (br. pn. 1).
Left pulmonic area dilated in 66 cases: br. pn. 44; infl. 21; lobar 1.
- Moderate dil. 2: br. pn. 2
- Slight dil. 18: br. pn. 10; infl. 8
- No dil. 3: br. pn. 1; infl. 2

Left ventricle dilated in 30 cases: br. pn. 25; infl. 5.
- Moderate dil. 1: br. pn. 1
- Slight dil. 14: br. pn. 10; infl. 4
- No dil. 43: br. pn. 19; infl. 23; lobar 1
- Questionable 1: infl. 1

Aorta dilated in 62 cases: br. pn. 41; infl. 20; lobar 1.
- Moderate dil. 2: br. pn. 1; infl. 1
- Slight dil. 17: br. pn. 9; infl. 8
- No dil. 8: br. pn. 5; infl. 3

Progress of Disease Radiologically in Pneumonias and Bronchopneumonias (includes all groups).

Onset	*Progress*	
Both hila to	both bases	9
	left base	2
	right base	1
	both middle	3
	left upper and middle and rt. lower	2
	left middle	2
	left middle and rt. lower	1
	left middle and rt. upper	3
	left lower and rt. middle	1
	right base and left middle	1
	right base and left middle and base	1
	right middle and upper and left middle	1
	No extension	1
Right hilus to	base	5
	middle and lower	1
	middle	2
	upper	2
	left middle and upper	1
	right upper and left middle	2
Left hilus to	base	1
	base and middle	3
	middle, upper and lower	1
	middle	4
Right base to	right middle and upper	1
	left hilus and middle	1
	right middle and left lower	1
	No extension	1

Right middle to right upper and lower	1
Right lung, base to apex to left base	1
Left lower to right lower and middle	1
Left upper and lower right and left upper, middle and lower	1
Left middle to left upper and right upper	1

Corps Men, Officers and Nurses. Physical and Radiological Signs Compared.

Average *Age* 32.

Clinical Signs.
- Severe 8: br. pn. 5; infl. 3.
- Moderate 31: br. pn. 25; infl. 5; lobar 1.
- Mild 33: br. pn. 15; infl. 18.

Radiological Exam.
- Marked changes 36: br. pn. 33; infl. 1; lob. 2.
- Slight changes 38: br. pn. 14; infl. 24.

Clinical Changes.
- *Breathing*, br. 17: br. pn. 15; infl. 1; lob. 1.
- Bron. vesc. 13: br. pn. 19; infl. 2.
- Harsh 14: br. pn. 10; infl. 3; lob. 1.
- Feeble 7: br. pn. 7.
- Dimin., distant 17: br. pn. 11; infl. 6.
- Negative 18: br. pn. 6; infl. 12.

Râles.
- Crep. 30: br. pn. 25; infl. 4; lob. 1.
- Subcrep. 30: br. pn. 20; infl. 9; lob. 1.
- Indetermin. 30: br. pn. 23; infl. 5; lob. 2.
- All kinds 2: br. pn. 2.
- Fine râles 2: br. pn. 2.
- Coarse râles 1: br. pn. 1.
- None 8: br. pn. 2; infl. 6.

Fremitus.
- Increased 42: br. pn. 30; infl. 10; lob. 2.
- Dimin., impaired 3: br. pn. 3.
- Pectoriloquy 1: br. pn. 1.
- Negative 28: br. pn. 14; infl. 14.

Dullness 57: br. pn. 42; infl. 13; lob. 2.
- Negative 17: br. pn. 6; infl. 11.

Heart Dilated 5: br. pn. 4; infl. 1.

X-ray signs preceding clinical signs, 2 cases, 1 by 3 days; 1 by 6 days.

Corps Men, Officers and Nurses. Physical and Radiological Signs Compared.

Temperature

Lowest Point	96°	21	Highest Point	106°	1
	97°	36		105°	5
	98°	4		104°	24
Above	99°	9		103°	21
Unknown		4	Below	102°	20
			Unknown		3

Pulse

Lowest Point	42	1	Highest Point	160	2
	48	1		152	3
	50	2		136	1
	52	6		132	1
	54	2		128	2
	56	6		124	1
Above	60 to 96	50	Below	120 to 96	53

Respiration

Lowest Point	14	3	Highest Point	80	1
	16	11		64	3
	18	43		60	1
Above	20 to 26	14		58	1
				56	3
			Below	52 to 26	62

Tuberculosis Cases. Physical and Radiological Signs Compared

Average *Age* 25.

Clinical Signs.
- Severe 3: br. pn. 3.
- Moderate 7: br. pn. 4; infl. 1; lob. 2.
- Mild 5: br. pn. 2; infl. 2; lob. 1.

Radiological Exam.
- Marked changes 9: br. pn. 7; lob. 2.
- Slight changes 6: br. pn. 2; infl. 3; lob. 1.

Clinical Changes.
- Bron. *breathing* 3: br. pn. 3.
- Bron. vesc. *breathing* 2: br. pn. 1; pn. 1.
- Harsh *breathing* 2: br. pn.2.
- All kinds 1: lob. 1.

Râles.
- Crepitant 4: br. pn. 3; pn. 1.
- Subcrepitant 3: br. pn. 3.
- Bubbling 2: br. pn. 2.
- Indetermiate 1: infl. 1.
- All kinds 3: br. pn. 1; pn. 2.
- None 2: infl. 2.

Fremitus.
- Increased 3: br. pn. 2; lob. 1.

Dullness 10: br. pn. 7; lob. 3.

Temperature

Lowest Point	96°	2	Highest Point	100°	7
	97°	2		103°	5
	98°	5		102°	2
	99°	4		100°	1
	101°	1			

Respiration

Lowest Point	14	1	Highest Point	60	1
	16	2		48	1
	18	5	Below	40 to 24	13
	20	6			
	22	1			

Pulse

Lowest Point	45	1	Highest Point	146	1
	56	1		140	1
Above	60 to 100	13		126	1
			Below	120 to 100	11

Number of cases in which radiological diagnosis of bronchopneumonia was made upon first examination	6
Lobar pneumonia	4
Influenza	5
Final radiological diagnosis of bronchopneumonia	9
Lobar pneumonia	3
Influenza	3

Radiological Signs

The author takes this opportunity to acknowledge his indebtedness to Lieutenant Edward I. Liss for his very valuable assistance and to express his thanks for the efforts of the *x*-ray staff.

COMPLICATIONS OF INFLUENZA FROM THE ROENTGENOLOGICAL STANDPOINT*

BY RUSSELL H. BOGGS, P. A. SURG., U. S. N.

PITTSBURGH, PA.

THE complications of influenza were studied by the roentgen rays at the United States Naval Hospital, Philadelphia, all the plates being taken stereoscopically with a few exceptions when the patients were too sick to be moved. The plates were studied in conjunction with the various staff officers, and the shadows shown were accounted for clinically, by operation or autopsy. Many of the patients were examined repeatedly, which made the series of cases examined extremely interesting. The picture of the pneumonic process was a lobular bronchopneumonia and appeared anatomically usually in a disseminated form. The foci were very near together and confluent in certain parts of the lungs, and in others obscure and far apart. The stereoscopic picture showed the image to be made up of a series of distinct shadows more or less confluent, and in most cases separated one from another by clear spaces. In some cases the appearance of certain forms of chronic tuberculosis was simulated.

It is evident that an influenza bronchopneumonia may give a stereoscopic picture analogous to certain forms of tuberculosis, and that it is only by care and by knowing the clinical side of the case that the true nature of the pulmonary process may be ascertained. When examined by a single roentgenogram in these influenza pneumonias one would be impressed that the lung cast a rather dense shadow in certain regions; but when a stereoscopic pair of plates were examined the apparent densities seen on a single plate were shown to be caused by added shadows throughout the lung tissue, and this was the reason that in so many cases so little was obtained by percussion. After studying a series of cases by the roentgen rays it was interesting to note the accuracy with which we could tell the kind of breathing the lung densities would produce, namely, bronchial, bronchovesicular, etc.

The influenza chest of a very sick patient would usually give a rather characteristic picture. The glands varied in size from a grain of shot to a pea or even larger, and had a clear cut edge, as though each was injected with a rather dense material. This, together with prominent hilus shadows and increased linear markings of the lung fields, was called an influenza chest. If the glands were very prominent with some confluent areas of consolidation, the patient was always found to be very sick. The differences in the linear markings from those found in the tuberculous lung were that they were more general, and usually found in both lungs. These lines continue plus for some time after influenza, and a differential diagnosis from tuberculosis is going to be extremely difficult. This is bound to be a source of error during the next two or three months. Some of these influenza chests, having prominent linear markings, have been examined repeatedly since their recovery, and the plates showed that these markings were slow in disappearing. Influenza frequently caused the so-called fan-shaped markings described by Dunham, which are supposed to be diagnostic of tuberculosis. Influenza seemed to make a tuberculous process more active, this being particularly true in latent cases. Thickened pleura or effusions are clearly shown roentgenologically. The layers of the pleura are only visible in the pathological state when inflammation has produced a thickened pleura or a serofibrinous deposit on its walls.

During the recent influenza epidemic large pleural effusions were not very common, but small collections of circumscribed effusions or thickened pleura were frequently

* Read at the Midwinter Meeting of the American Roentgen Ray Society.

seen. The large pleural effusions presented the usual roentgen ray findings and offered no difficulty in interpretation. There were a few instances in which extensive thickened pleura with a plastic exudate of the lower lobe simulated a large pleural effusion roentgenologically, except that there was no displacement of the heart or change of level of the density with position. The diaphragm shadow was lost, and it was fixed by pleural adhesions. To confuse further findings, often a partly solidified lung was present. Then the differential diagnosis required all the skill of the internist and the roentgenologist. Several such cases were confusing to all, and in one case in particular the patient was not referred to the roentgen ray laboratory until his temperature was running a normal course.

In many of these thickened pleuras, with a small amount of effusion, the temperature was the most diagnostic clinical symptom, because the patients' degree of sickness was too acute to be accounted for by the physical findings alone. By hasty interpretation in many of these cases, a large pleural effusion would have been diagnosed when only thickened pleura with an aplastic exudate was the cause of the extensive shadow. As a rule, the diagnosis of pleural effusions belongs to the clinician and is only confirmed by the roentgen ray. However, under certain circumstances the roentgen method plays an important part, not only in the diagnosis but also in determining the treatment that is advisable. The pleura effusion may be of small amount, but associated with more or less pulmonary consolidation. This will modify considerably the physical findings as well as the roentgen image.

After pneumonia, sometimes the temperature returns and the symptoms are aggravated. Then the question arises whether it is a pneumonic process with slow resolution and the symptoms aggravated, or whether it is pleurisy. The clinician is often unable to state what positively exists, and auscultation reveals such miscellaneous pleural and pulmonary signs that they are difficult to interpret. Some dullness persists and it is almost impossible to draw positive conclusions. The question of interlobular or a circumscribed pleurisy arises, and the roentgen study carefully considered with the clinical symptoms has been found to be of extreme value. Here the interpretation of the plate is not easy, and the roentgenologist must be a physician and one who can interpret his findings in conjunction with the clinical findings presented by the internist. In fact, the roentgenological examination is not conclusive, but it is necessary to interpret what is seen and draw conclusions for a useful diagnosis. The difficulty of interpreting chest plates demands an accurate knowledge of anatomy, physiology and pathology, and consequently cannot be done by anyone but a physician who knows the normal, and knows what abnormal shadows are cast by the various pathological lesions. Roentgenology has become a science; but there is need of greater collaboration between the physician and the roentgenologist.

As before stated, the clinical diagnosis of circumscribed pleurisy is difficult clinically; and the roentgen method, therefore, becomes of the greatest use in detecting small effusions. But it is not limited to that alone, because many of these small purulent effusions need immediate intervention. The exact location of the effusion can be determined, and the plates will show from what point it should be approached. The roentgen image of interlobar pleurisy with effusion is quite characteristic, consisting of a traverse band which entirely crosses the pulmonary field and divides the lung into three zones. If the pleural effusion is limited to the interlobar space and is slight, the respiratory movements of the diaphragm may be only slightly interfered with. Interlobar pleurisy with effusion was found to be rare; the circumscribed was more common, and often found in the axillary region.

In studying the chest of these influenza cases, I was struck very forcibly by the

fact that we really had no standard normal lung roentgenogram any more than we had a standard normal roentgenogram of the stomach. It is well known that an examination of healthy individuals without any lung infection of any type will reveal a widely different picture as to the character and thickness of the bronchial trees and also a vast difference in the general density of the lung fields. Therefore, before we are able to interpret chest findings roentgenologically, we must always study the history of the case and know what changes have occurred in the lungs prior to the condition under examination. This study should include the various diseases that the patient may have had, and the changes due to inhalation of various particles of dust, such as results from patients having worked in mines or in cement works, or even from having lived in some cities.

Again, the study of a series of chest plates of healthy individuals, without any history of disease whatever, and who have lived under favorable conditions, will show that the hilus and parenchyma vary considerably. The diagnosis of tuberculosis is always considered in the study of any chest, since a patient may have had a latent affection without any history of the disease. A study of the various changes of the lungs which are likely to take place during life without the history of any pulmonary disease, or of those which are so minor as to escape detection must be carefully considered. We all know that the bronchial tree and the lung fields give a different appearance in a healthy child five or ten years of age as compared with a person of sixty or seventy years of age, depending on many conditions. Possibly the lungs might be compared to the skin, which in childhood is firm and elastic, and in old people wrinkled, atrophic, etc., both conditions being normal for the individual.

In conclusion, the roentgen rays as a means of diagnosing and recording the changes in the lungs and pleura are not directly diagnostic; but when compared with inspection, palpation, percussion and auscultation they yield much more accurate information than can be obtained by physical signs alone. It is a more accurate method than percussion alone, because even deep percussion is not accurate more than two and one-half inches below the surface, and the density in the lungs and pleura can be better compared with the normal and surrounding or adjacent organs and tissue. Stereoscopic plates taken anteriorly and posteriorly show the density and thickness of a pneumonic lung or a layer of fluid in the pleural cavity. By knowing the thickness and density of the pathologic lesion in the lung or pleura, or both together, with its position, one can usually tell what kind of breathing is heard by the stethoscope. The fluoroscope is a valuable aid to the roentgenologist for chest examinations in showing that much of the function of the lungs is disturbed by the pulmonary disease; but it cannot take the place of a good pair of stereoscopic plates taken posteriorly and anteriorly.

The value of taking plates stereoscopically, both anteriorly and posteriorly, must not be neglected, because an image of density nearest the plate is always copied the most accurately and distinctly. By taking anterior and posterior plates, we are able to determine the situation of the lesion, which could not be done by anterior or posterior plates alone. It therefore follows that one who makes his diagnosis by the fluoroscope alone is never making a complete examination of the chest by roentgenology. Less dependence should be placed on a fluoroscope and more on stereoscopic plates taken anterior-posteriorly and posterior-anteriorly. Unfortunately, we have strong advocates of both methods, whereas the fact is that it is only by a combination of both, together with a complete history, observation of symptoms, familiarity with different forms of lung pathology, and by careful physical examination, that a diagnosis should be

made. Without these a diagnosis should never be attempted. At present, in a great many institutions, the history taking and the roentgen ray examinations are usually left to the inexperienced. The most important and the most difficult thing to obtain in chest examinations, in the past, has been team work. A physical diagnostician may excel by his own method just as a roentgenologist of experience and judgment will in his, or as the older physician will in inspection or personal history taking; but this will not compensate for lack of team work.

At the United States Naval Hospital, Philadelphia, it was the excellent team work instituted by Dr. W. A. Angwin and carried out by the various ward officers and heads of the laboratories, in conjunction with consultants, Drs. Hare, DeLand, DeCosta and Pancoast, that produced such satisfactory and splendid results.

WINGED AMBULANCES OF THE UNITED STATES ARMY

Following the example of certain of the European armies, the United States Army has of late been experimenting with an aerial ambulance with the object of evolving a rapid and convenient means of transporting severely wounded soldiers from the battlefield to the base hospital.

The American winged ambulance is a modified Curtiss two-seater biplane, arranged with a removable top section in the fuselage, just back of the pilot's seat. The removable panel permits of readily placing the litter with its human freight into the airplane body; whereupon the panel is replaced so as to protect the wounded man from the cold and wind. The airplane, in this case, is painted white and marked with conspicuous red crosses so as to distinguish it from fighting craft.

In the latest forms of French flying ambulances the equipment is quite complete. Among the things carried are portable stoves, a complete *x*-ray outfit operating from a generator on the airplane, the necessary surgical instruments and supplies, and a simple tent. However, the French have been working on the problem of flying ambulances for upward of two years, and are therefore further along with the matter than we are at present.—*Scientific American*, Vol. CXIX, No. 23.

THE CALDWELL PORTABLE ROENTGEN RAY OUTFIT

BY C. N. MOORE

SCHENECTADY, N. Y.

THE need of a portable roentgen ray outfit which can be taken to the bedside in emergency cases has long been felt by the roentgenologist. Dr. Caldwell, with his characteristic skill and ingenuity, built up in his laboratory a simple, light-weight, reliable coil outfit of sufficient capacity for this purpose. The following is a brief description of the outfit as he had been using it for some time in his general practice.

General Description. — The apparatus consists esssentially of three units, as shown in the accompanying photographs; namely, an induction coil with attached tube holder and tube, an instrument box, and a mercury turbine interrupter. The necessary wires for connecting the various units together complete the outfit. Each unit is compactly assembled and is of such a weight that it can be conveniently carried by the handle provided. The connecting wires are provided with suitable plugs so that the complete outfit can be very quickly and correctly assembled ready for use.

Induction Coil.—The induction coil (Fig. 1) is mounted vertically in a wooden case 10 inches square and 18¾ inches high. This case is provided with a cover, divided in the center and hinged at each side, which is opened when the coil is in use. Mounted on the covers are series spark gaps and reels for the high-tension circuit. The opening between series spark gaps can be adjusted by means of hard-rubber levers pivoted on the cover.

The high-tension leads from the coil are brought up through a hard-rubber partition in the top of the case by means of suitable bushings located in diagonally opposite corners. Permanent connections are made from the tops of the bushings to the series gaps and thence to the reels and to a parallel spark gap, which is mounted on two hard-rubber posts and which is controlled by means of a hard-rubber rod with a knurled head. Milliammeter leads from the middle of the secondary winding of the coil, together with the low-tension leads, are brought up through a bushing in one corner of the top of the case. Both milliammeter and low-tension leads are provided with a common terminal block

FIG. 1.

through which connections are made with the instrument box. All of these various devices are so arranged that the cover can be closed without their interfering with one another.

The tube holder is fastened to the side of the case and consists of a wooden arm with three friction joints, which make it possible to locate the tube in any desired position. It provides for an overhang of 34 inches in

the extreme position, and folds compactly at the side of the case when not in use.

The total weight of the coil, case, and tube holder is 52 pounds. A heavy strap fastened to the sides of the case is provided for carrying the unit.

The tube used with the outfit is a small Piffard gas tube made by Machlett & Co.

Instrument Box.—The instrument box (Fig. 2) consists of a wooden case 9 inches wide, 16 inches long and 6½ inches high, provided with a hinged cover and a suitable handle. Mounted on a hard-rubber panel inside the case are the various meters, switches, attaching plugs, etc., necessary for the operation of the coil and interrupter. The meters consist of a D.C. voltmeter for measuring the line voltage, a milliammeter for measuring the current through the tube, and a D.C. ammeter for measuring the current in the primary of the induction coil. Connections to the supply line, to the motor of the interrupter, to the interrupter, and to a hand switch are made at the four attaching plugs at the bottom of the panel, and to the coil at the terminal block above the milliammeter. A push button switch for operating the interrupter motor is located on the panel; also a fuse plug in the main line circuit. A condenser connected in parallel with the primary of the induction coil is placed in the box under the panel.

The instrument case complete weighs about 22 pounds.

Interrupter.—The interrupter (Fig. 3) used is a Sanax mercury turbine with kerosene dielectric. It is suspended from a light-weight wooden framework so that it swings freely in a vertical position and

Fig. 2.

Fig. 3.

runs very quietly. The unit weighs 34 pounds and is carried by means of a rope handle.

Assembly.—The outfit as assembled for use is shown in Fig. 4. The induction coil is placed upon a chair or suitable bench at the bedside and the instrument box and coil in some convenient position nearby. A plate-changing tunnel (Fig. 5) is usually used for holding the plate in the envelope or cassette.

Carrying Case.—For transporting the complete outfit to the bedside, the tube is placed in a felt-lined wooden case, and this, together with the instrument box, connecting wires, plates, etc., is packed in one large carrying case (Fig. 6), 27 inches long, 10½ inches wide and 19 inches high. The coil and the interrupter are carried separately.

Operation.—The outfit is intended to be operated on about 115 volts D.C., and under these conditions will give 10 milliamperes at about a 4½-inch parallel spark

FIG. 4.

gap, drawing about 7 amperes from the line.

Field of Usefulness.—By the use of this apparatus one can secure very satisfactory plates of any part of the body. Perhaps its greatest field of usefulness has been in fractures and in lung examinations. Very satisfactory lung plates may be obtained in five to eight seconds at a plate target distance of 30 inches, while a lateral of the knee may be secured in about two to five seconds.

Examinations of the mastoid cells and of the accessory nasal sinuses have been successfully undertaken, and shadows of kidney stones and gall stones have also been demonstrated by its use.

FIG. 5.

FIG. 6.

SUPERFICIAL EPITHELIOMAS

De Rezende calls attention anew to the excellent results he has obtained in treatment of epitheliomas of the skin with a salve which penetrates rapidly into the tissues and requires no dressing to hold it in place. In five cases during the last three years the epithelioma of from three to six years' standing was completely cured with one or two applications a week, first removing crusts and dead tissue, and suspending the applications if the tissues around become inflamed. Illustrations are given of some of the cases. The formula calls for 0.20 gm. each of arsenious acid, copper sulphate, methylene blue and methyl violet; with 0.50 gm. quinin hydrochloride; 0.75 gm. tartar emetic, and 1 gm. each of camphor, menthol, phenol and antipyrin. The last four ingredients are mixed together first. They deliquesce and form the vehicle for the other ingredients which are added in turn, leaving the methylene blue and methyl violet till the last. He describes the special function expected of each of these ingredients.—*J. Am. M. Ass.*, Nov., 1918. Cur. Med. Lit.

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THE FUTURE OF RADIUM

In every article or substance in the universe three stages have to be distinguished: past, present and future. But the world is confronted with the task of investigating and defining what the past, present and future stages have been, are or will be. The present uses and qualities of an article or substance are more or less a matter of ocular or physical demonstration; their past can generally be investigated with a fair amount of satisfaction; and the future, while always speculative, can be fairly prognosticated based on present and past performances.

Radium makes an exception in this as well as in other vital respects. In spite of the light it sheds, both physically and mentally, it leaves us in the dark as to its past, present and future stages. In the consideration of any proposition the present stage is always the most tangible; it is the pivotal center from which to work in all directions, backward and forward, and from the explorative information thus gained further conclusions are justified, increasing the knowledge of the world.

As adepts of the healing art, we are principally concerned in the present stage of radium, and it must be confessed that the opinions of accepted authorities differ widely, ranging as they do from unbounded enthusiasm to the rankest pessimism. He who contents himself with the philosophical attitude that the truth will probably lie somewhere between, may be satisfied with allowing things to take the even tenor of their way, accepting whatever good or bad Nature may have in store for us.

Not so the true scientist. While enthusiasm is a prerequisite in the successful performance of arduous researches, it should not be one-sided or biased either in favor or condemnation of the subject to be investigated. The successful investigator must be broadminded and have his physical and mental eyes wide open. The skilful surgeon is apt to place the efficiency of the knife in accessible cancer above the curative, palliative or destructive action of radium; he is at pains to find fault with radioactivity—not because he thinks that radioactivity is no good but because he thinks that surgery is better. He exemplifies the type of whom it may be said, "Once a surgeon, always a surgeon." Such an attitude is not scientifically justified, and the same holds good for the opposite

extreme. Radium enthusiasts claim successes which, although unquestionably true in certain cases, are not sufficiently uniform to be accepted as an equivalent or superior substitute for surgery in all similar cases as a routine proceeding.

These considerations go to show that the present stage of radium, our knowledge of what radium is and what it can accomplish, is still insufficiently explored. A systematic compilation of scientifically sifted facts and figures would help in establishing at least a basis upon which further scientific deductions can be carried on.

At a recent address, delivered before the Astronomical Society of Los Angeles (*Radium, May, 1917*) Willett L. Hardin expressed this task in the following words: "When we consider the new and unexplored world which radioactivity has revealed, the intimate knowledge it has given us of the constitution of matter, the possible influence of radioactive substances in geologic and cosmic phenomena, the possibilities which the vast stores of energy have suggested and the influence of radioactive rays on the vital functions of the living cell, it is impossible to say what part radioactivity may have played and is playing in the economy of Nature."

Thus, there are infinite possibilities in store for us, so far as the future of radium is concerned, and from this standpoint it is worse than useless to try to lay down definite axioms, for instance, for or against the curability of cancer by radium with nothing better to guide us than the comparatively meager attainments in the present stage of our knowledge.

The daily press is one of the worst offenders in this respect. The members of the "fourth estate" are apt to exaggerate, and this refers with more than usual force to their handling of so mysterious a substance as radium. It matters little to them whether the "news" they print damn or praise a new science, as long as it is sensational. This undesirable feature was well illustrated in the case of the radium report issued in 1916 by Dr. F. C. Wood as head of the Crocker Cancer Research Fund, which was distorted in the daily press of almost the entire country as showing radium to be a failure in the cure of cancer.

Even while in the present stage of our knowledge and technical achievements radium has not been exploited to the full extent of its possibilities, those investigators who have gone most deeply into the subject hold out the brightest hopes for the future. This conviction is expressed by Hardin in the following words:

"Radio-activity has revealed the fact that the atom is a great storehouse of energy. What influence this discovery may exert upon the human race remains for the future to determine. Realizing that human life is so intimately dependent upon an adequate supply of energy, it is interesting to contemplate the result of being able to control and utilize the potential energy of the atom. It would probably cause more radical changes in our customs and habits than any combination of social and political influences could produce. It would make us independent of heat and cold, of drought and flood, and it would enable us to 'transform a desert continent and thaw the frozen poles.' "

Soddy goes a step farther. He considers it possible that radio-activity, including atomic transformation, is competent to be the mainspring of the universe. If such should prove to be true, with all the consequences contingent upon that knowledge, the radium cure of cancer, reasonably speaking, should become as easy a matter as the opening of a rose bud under the influence of the sun.

CORRESPONDENCE

ROENTGEN SOCIETY.

33 Newton Street,
High Holborn, W.C. 2, England.
25th February, 1919.

The Editor,
The American Journal of Roentgenology,
67–69 East 59th Street,
New York.

DEAR SIR:

As a corresponding Member of the American Roentgen Society I was most interested in the article on the Caldwell Stereo fluoroscope appearing in your December number, and this was particularly engaging to me, as it deals with an instrument which has been worked out in this country to perform the same purpose, although the method by which it is obtained is somewhat different.

The Stereo fluoroscope to which I refer has one advantage over the Dr. Caldwell instrument, as it does not require alternating current or special motors of any kind. It will work just as easily from an interrupterless high tension rectifier as from an ordinary induction coil with interrupter, and is provisionally protected.

My reason, however, in writing was not to refer to this but to draw attention to the diagram on page 548 which surely is not quite correct.

The image which is cast by the tube F1 in that diagram should surely be viewed by the eye E1 and the image which is cast by the anti-cathode F2 should be viewed by the eye E2.

This is conveyed by the text; but curiously enough the diagram is in error in making the lines of vision cross over between the eyes and the shadow on the screen. The lines from the screen F2 should have been produced to E2 not to E1.

This diagram may be somewhat misleading to those who have not studied stereoscopic vision, and that must be my sole excuse in referring to it.

Perhaps the whole principle of stereoscopic vision will be explained very much more simply by the enclosed diagram.

Figure 1 shows a solid object viewed by two eyes, the left eye observing the front and the side while the right eye sees only the front.

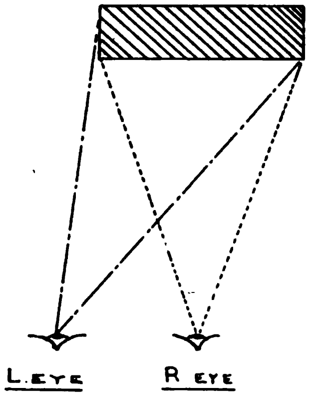
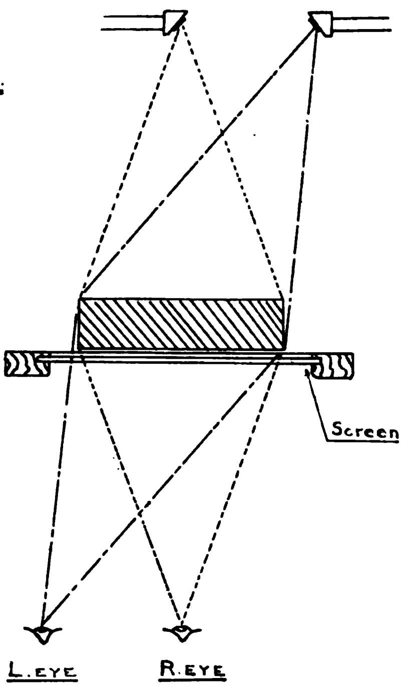


FIG. 1.

Figure 2 shows the same diagram but with a fluorescent screen interposed between the eyes and the object of each; a shadow will have to be cast similar to that in the lines of vision shown.

FIG. 2.



This can obviously only be done by tubes in a corresponding position, and the diagram will clearly show that the image projected by the right tube must be seen by the left eye, if a true stereoscopic effect is to be obtained, otherwise the effect is pseudo-stereoscopic, which means that the whole of the relief is reversed.

Yours truly,

GEOFFREY PEARCE,

Hon. Treasurer.

New York City, April 7, 1919.

The Editor,

The American Journal of Roentgenology.

DEAR SIR:

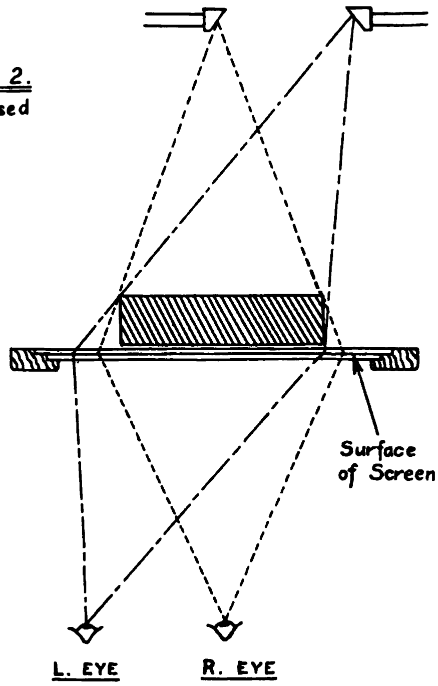
The diagram on page 548 unfortunately does not agree with the text, inasmuch as it shows the shutter in proper phase for pseudoscopic rather than true stereoscopic vision. However, this is fully as useful as true stereoscopic vision in many instances, and it is especially valuable in the localization of foreign bodies. The change may be instantly made from one type of vision to the other at the will of the operator by throwing a pole changing switch in the transformer primary circuit.

Fig. 2 of Dr. Pearce's explanation is hardly in accordance with the facts, since the observer sees only the screen image and not the object behind the screen. This diagram is shown herewith in a revised form.

Very truly yours,

LIVINGSTON MIDDLEDITCH, JR.

FIG. 2.
Revised



NOTICE OF ANNUAL MEETING

The Twentieth Annual Meeting of the American Roentgen Ray Society will be held in Saratoga Springs, New York, Wednesday to Saturday, September 3rd, 4th, 5th and 6th. Several features of the program have been decided and others are under consideration. One afternoon will be spent in the Research Laboratory of the General Electric Company at Schenectady, the Society being the guest of Dr. W. D. Coolidge. It is hoped to give another afternoon to recreation; the vicinity of Saratoga Springs abounding in points of natural beauty and historic interest. There will be a banquet on one evening to which the visiting ladies will be welcomed. Another evening will be given to the lantern slide demonstration of case reports. It is hoped that we may also devote a part of one session to the lantern slide demonstration of laboratory devices and similar items of technical import.

The headquarters of the Society will be at the Grand Union Hotel, and it is suggested that early reservation be made by those who expect to attend the meeting. Special rates have been obtained for members of the Society.

RESOLUTIONS ADOPTED BY THE PACIFIC COAST ROENTGEN RAY SOCIETY

RESOLVED:

1. That the practice of roentgenology is an important branch of medicine and surgery and should be recognized as such.

2. As a special branch of medicine and surgery its practice should be confined to those qualified by education and experience, viz., by licensed practitioners of medicine and dentistry.

3. That the California State Medical Society should act with the State Dental Society to legally establish the status of roentgenology by introducing into the legislature such additions to our laws as may be necessary.

4. That persons who are not licensed physicians or dentists be allowed to act as roentgen technicians in hospitals or in offices of physicians or dentists only after examination and licensing by the respective Board of State Medical and Dental Examiners and that it shall be unlawful for such technicians to render roentgen diagnosis or interpretations.

ANNUAL MEETING OF THE AMERICAN RADIUM SOCIETY

The next annual meeting of the American Radium Society will be held at Atlantic City, New Jersey, Monday, June 9th, at the Seaside House.

Dr. Henry K. Pancoast,
Secretary.

TRANSLATIONS & ABSTRACTS

EGGERS, CARL. Empyema—Analysis of 70 Cases at Base Hospital, Camp Jackson, S. C. (*Surg., Gyn. & Obst.*, April, 1919.)

The clinical types and surgical treatment of empyema are discussed at length. In discussing the diagnosis he states that:

"Though according to text books the detection of fluid in the thoracic cavity should be quite easy, it is by no means always that. It is by the careful examination of the chest, done daily and recorded on the chart that the presence of fluid is first suspected. By this systematic work, the variation in signs from the previous day or days will be noted. Displacements of the heart are of great value. By having had the patient under observation for some time, one is familiar with the organism causing the infection and can be on the lookout. It is important that the presence of large amounts of fluid be detected early and that it be submitted to bacteriological examination, because one is guided in the treatment largely by the laboratory findings. It is interesting with what rapidity the fluid sometimes develops. However, at times all physical signs fail, and it is familiar to those who do much of this work how deceptive signs may be. It is probably not putting it too strongly when we state that fluid in the chest may give the exact physical signs of a pneumonia and vice versa. Therefore, when a suspicion of fluid exists, whether early in the disease or because the lung condition does not clear up as promptly as it should, one should never hesitate to use the aspirating needle. If properly introduced no harm can result. It should be of sufficient length and calibre and be introduced attached to the syringe with the piston pushed down. In this way the entrance of air is prevented. There is no place of selection for the exploration, it must be done wherever the fluid is suspected.

"If these means fail, the *x*-ray has proved of great value, particularly in the smaller encapsulated varieties of empyema. In doubtful cases, therefore, an *x*-ray should be made, preferably a stereoscopic, and if a focus is found, exploratory puncture should be done under guidance of the plate. The fact that two of our patients were sent to duty after their pneumonia and later returned for an encapsulated empyema might suggest that all pneumonia patients should be *x*-rayed before being discharged."

BECK, E. G. The Empyema Problem. (*Surg., Gyn. & Obst.*, April, 1919.)

The stereoroentgenogram and the probatory puncture are considered corroborative evidence in the early recognition of empyema. As soon as percussion and auscultation have shown that a certain portion of the chest is abnormal, stereoroentgenograms are made. The following conditions must be considered:

1. Unresolved lobar pneumonia.
2. Acute active bronchopneumonia.
3. Fluid in the pleura, serous or purulent.
4. Lung abscesses.
5. Pneumothorax.
6. Acute pulmonary tuberculosis.

He insists upon the correct interpretation of the stereoroentgenogram. His opinion is based upon the following:

1. *Unresolved Pneumonia.*—A dense shadow corresponding to any of the five lobes, with the rest of the lung comparatively normal, indicates an unresolved pneumonia. An abscess rarely produces a shadow which would correspond to the shape of a single lobe. It would produce transparent areas representing lung tissue around the abscess and possibly show a dense shadow of the abscess wall which the unresolved pneumonia does not produce.

2. *Bronchopneumonia* gives an entirely different picture. At times both lungs are involved and the picture resembles more that of an advanced tuberculosis of the lung. The entire lung (or parts of it) is studded with shadows varying in size from that of a hazelnut to that of an egg; these shadows sometimes merge into one another and leave transparent areas between them.

3. *Fluid in the Pleural Cavity.*—When the pleural cavity is entirely filled with fluid, the lung is compressed toward the hilus. If no adhesions are present it retracts upward and posteriorly. The roentgenogram of this condition will present a shadow resembling ground glass, nearly equal in density throughout the entire area occupied by the fluid. This, how-

ever, is true only when the patient is on his back while roentgenized, because the fluid gravitates and covers the entire posterior area of the pleural cavity. In cases in which the quantity of fluid is not large and the roentgenogram is made in the standing or sitting posture, we shall obtain a characteristic appearance; the fluid will gravitate into the lowest part of the pleura and produce a dense shadow up to its upper margin; above that there will be a distinct pneumothorax. Another roentgenogram made in the lateral position, namely with the patient lying on the affected side, will produce a shadow corresponding to the level of the fluid along the outer part of the chest, and a pneumothorax between the margin of the retracted lung and the level of the gravitating fluid. If the same patient is turned on the unaffected side the fluid will gravitate toward the middle line and leave a pneumothorax externally.

The roentgenogram will give us scant information as to the character of the fluid, except that the purulent fluid is likely to give a denser shadow than the serous. It requires probatory puncture to settle this question.

4. *Lung Abscess.*—The diagnosis of a lung abscess is more difficult. A patient may have had an encapsulated pocket of pus in his lung for months and even years before a diagnosis is made. Its location by physical examination is more difficult because it is usually centrally located and, as a rule, much smaller than an empyema. The tuberculous abscess has a distinct wall and is more often multiple and, therefore, much more easily diagnosed than that resulting from a pneumonia or other causes. When a patient gives a history of having suddenly spit up a quantity of pus and continues to expectorate purulent material, the presence of a lung abscess must be considered. After an abscess has ruptured into a bronchus, its localization becomes more difficult still, because the sac has collapsed, and a probatory puncture will in most instances fail to strike the pus cavity.

5. *Pneumothorax.*—There should be no difficulty in diagnosing a pneumothorax, as the physical signs are very characteristic, especially the hyperresonance. The roentgenogram, however, is most convincing. We find here the absence of shadows in a well defined area which means that the lung has retracted and the space is not occupied by fluid but by air, which of course produces no shadow whatever.

6. *Advanced Pulmonary Tuberculosis* with abscess will in the roentgenogram resemble very much a bronchopneumonia, showing areas of infiltration of different sizes, and thus the history and clinical findings must assist us in our diagnosis. The healed out tuberculous process, however, gives a characteristic picture, namely, an apparently transparent lung with fine linear markings, corresponding to the bronchi, with many small, distinctly outlined shadows of calcified deposits and many concrete shadows resembling snowflakes, which represent fine scars remaining from a healed out tuberculosis.

Action of the Roentgen Rays on the Chronic Leucemias. (*Med. Rec.*, April 12, 1919.)

There is both a quantitative and a qualitative action of the roentgen rays on the blood. The number of white cells progressively decreases in striking proportions and in one case of myeloid leucemia Beaujard noted that in seven months the number of white cells per cubic millimeter dropped from 235,000 to 5,400. This leucocytic drop continued for several days following the application of the rays. From the qualitative viewpoint, the destruction is especially evident for the myelocytes, their proportion dropping from 50 per cent to 1 or 2 per cent in a few weeks. At the same time, the number of erythrocytes rapidly increases to such an extent that in a month the increase may amount to one million. This rise in red cells is not parallel to the inverse phenomenon observed in the whites, for when the influence of the irradiations appears to have become spent on the leucocytes the rise in the number of red cells will be found to continue for some time longer.

The size of the spleen diminishes astonishingly because in a few months a spleen almost filling the abdomen may be reduced to a practically normal size. In other cases the reduction takes place more slowly. The same retrogression in the lymph-nodes likewise takes place. From ten to twenty days at the most after beginning the treatment the general health is sensibly ameliorated, the edema subsides, and the patient's appetite returns. This improvement does not necessarily coincide with a return of the blood to the normal, but

there nevertheless is a close correlation between them. The improvement in health persists as long as the number of erythrocytes is on the increase, which indicates that the roentgen rays continue their beneficial excitation of the formative organs of the red cells. The activity of this hematopoietic elaboration is the principal act; the drop in the white cells is secondary, as analyses of the blood, when compared with the variations in the patient's health, will show.

Among the mechanisms offered for explaining the action of the roentgen rays in the leucemias, it has been supposed that they destroy the "morbid elements" and toxins secreted by these elements; but even should this conception be adopted, it must be admitted that no data of positive observation can be invoked in confirmation of such a view. If the conception of a bacterial action were admitted, if the leucemia were really caused by infectious germs, how could the cure or amelioration in the health be explained? In these circumstances it must be supposed that the rays favor the process of immunization of the organism against the causal infection, but until more ample information is at hand the results of experience alone should be taken into consideration, and we know of no bactericidal action resulting from the roentgen rays applied in therapeutic doses at present employed.

It is generally conceded that the decrease in the number of leucocytes results from their progressive destruction, because after a few exposures of the rays numerous degenerated leucocytes are found in the blood, while the increase of uric acid in the urine clearly testifies to this. A number of competent writers explain this destruction by the formation of a leucotoxin or a special lysin which results either from a biochemical change in the lecithin of the white cells or from cholin, an active product resulting from the splitting up of lecithin. That such a leucolysin exists has been proven and that it is produced in normal subjects exposed to roentgen rays has been demonstrated by Ambrozio, but instead of attributing an all powerful curative action to the roentgen rays in leucemia, it would seem more logical to assign to them a single exciting action on the defensive functions of the organism by stimulating the hematopoietic organs.

This mechanism has been explained by Roch. The spleen is the center of the formation of both red and white cells and is also the center of destruction of both, therefore it possesses four centers. An untreated leucemia is the result of an exaltation of the centers of white cell formation and destruction of red cells, and roentgen ray treatment attenuates their activity and at the same time stimulates the center of red cell formation and that of white cell destruction. Why this selective action of the rays? All four centers are stimulated, but the center of white cell formation and that of red cell destruction having reached a functional paroxysm on account of the morbid process, no longer respond to the stimulating action of the rays, while the other two, previously inactive, react with all their latent energy and an equilibrium becomes established. This conception has the advantage of being derived from physiology, while it is also compatible with the theory of the leucolysins, but in this case these are regarded as products of secretion of the macrophages of the spleen which enter into hyperactivity under the influence of the roentgen rays. All these hypotheses are laudable scientific efforts, but the subject has only begun to be studied and further work must be undertaken before any definite conclusion can be arrived at.

LANE, SIR ARBUTHNOT. The Clinical Symptoms of Chronic Intestinal Stasis. (*The Practitioner*, London, March, 1919.)

RADIOGRAPHIC ASPECT OF CHRONIC INTESTINAL STASIS

The clinical aspects of chronic intestinal stasis are roughly divided into two groups depending on the preponderance and the mechanical results of stasis or the associated results of autointoxication.

The value of the roentgen examination is dealt with at some length as follows:

"In dealing with any case of chronic intestinal stasis, it is necessary, besides obtaining a clear history of all the symptoms, to get a complete report from a radiologist, who is thoroughly familiar with this class of work, on the mode of passage of a bismuth meal along the entire length of the gastro-intestinal canal, and this should be supplemented by a bismuth enema. Many radiologists are of opinion that by providing the surgeon with a number of radiograms taken at intervals of time, the latter will be able to obtain from them

sufficient information to guide him in his treatment of the case. Nothing can be more incorrect than this belief, since the screen work affords by far the most valuable information. The main points are:

"(1) The length of period that the meal remains in the *stomach*, the behavior of the stomach, the mode of emptying.

"(2) The size and shape of the *duodenum*, the mode in which it evacuates its contents, the form of the duodeno-jejunal junction.

"(3) The length of time the meal remains in the *ileum*, the mode of its evacuation, the degree of thickening of the walls of the terminal coil, the relation of the appendix to the end of the ileum, the evidence of the presence of an ileal kink.

"(4) The size and position of the *cecum*, with possible indication of its rotation.

"(5) The mode of passage of the meal through the *large intestine*, the limitation by a band of the calibre of the bowel about the junction of the cecum and ascending colon in the transverse colon, just below the gall-bladder where the acquired ligament is attached, which connects the gall-bladder to the pylorus, duodenum, transverse colon, at the splenic flexure, and at the last kink at the left pelvic brim. The form of the bowel must be examined with a view to determine the presence of inflammation of its wall or of diverticulitis.

"The shape and size of the *pelvic colon* should also be carefully observed both in the case of the meal and in that of the enema, since this is a factor of the greatest importance. The presence or absence of gall-stones should be noted.

"Besides this, the *chest* should be investigated to show the condition of the lungs, glands, heart, and large vessels.

"It is difficult to exaggerate the importance of a thorough examination, since it not only furnishes the surgeon with complete evidence as to the mode of functioning of the canal, but it also not infrequently calls his attention to defects in the tract, which he would possibly or even probably have overlooked in operating for some definite condition.

"This happens in a large number of cases, sometimes because the surgeon does not realize the utility of a bismuth meal, at other times because one end-result of stasis presents symptoms that appear so perfectly characteristic that the operator is satisfied to confine his attentions to the treatment of this condition alone, being probably unaware of its causation and regarding it as a primary disease."

The effects of an abdominal support and of paraffin are discussed, and he states that paraffin should be discontinued for ten days before the roentgen examination is made.

Bloodgood, J. C. Treatment of Tumors of the Upper Jaw with Cautery. (*Dental Cosmos*, p. 341; from *Med. Rec.*, Feb. 15, 1919, p. 299.)

The mortality has been distinctly decreased with this method, and when cures have been accomplished it has been with less mutilation. Whether the actual number of cures has been increased cannot be demonstrated at the present time. The reduction in mortality is associated with the employment of local anesthesia alone, or in combination with light chloroform general anesthesia. In many instances it is safer to remove the disease involving the upper jaw in stages. In some of Bloodgood's cases there had been as many as fourteen operations.

The new growth should be attacked with the cautery from two points. One should burn the tissue at the border of the tumor. This not only destroys the infiltrating area, but excites in the healthy tissue beyond a granulation tissue which of itself is largely protective against secondary invasion, at least during the period of complete removal. The second attack should be upon the neoplasm itself—if possible, from the center out.

Burrows, Arthur. The Therapeutics of Radium. (*Brit. Med. Jour.*, March 15, 1919.)

The report of Dr. Arthur Burrows, radiologist to the Manchester and District Radium Institute, for 1918, describes the work done during that year and contains also a summary of the lessons that have been learnt and the results obtained during four years. The number of persons applying for treatment has increased and reached 648 in 1918. In 48 cases of malignant disease the patient was rendered free from symptoms and signs during the course of the year, and 18 out of 33 cases of rodent ulcer treated to a termination were cured. In the

summary of the four years it is stated that practically all early rodent ulcers can be cured by radium alone. To date, 31 cases have been well for two years or more, and of a number of other patients who have not reported it is believed that many are still well. With regard to the treatment of malignant disease, it is observed that at present only inoperable cases are treated by radium. In its use various factors have to be considered: extremely rapidly growing tumors, like melanotic sarcomata, cannot be expected to yield good results; it is also found that carcinoma of the tongue does not usually respond favorably to radium. Extremely large growths are apt to slough and ulcerate, and the tendency to resolution is small. Growths involving bone cannot as a rule be satisfactorily treated, but a case of periosteal sarcoma is illustrated, which remained well for twelve months and then died of another disease. Tumors which retain some mobility, have a good blood supply, and are surrounded by healthy tissues, generally respond best to radium treatment. So far, it has not been satisfactorily demonstrated that the histological nature of the tumor, with a few exceptions, has much bearing on the immediate result of radium treatment. The best results from radium treatment have been obtained in carcinoma of the cervix of the uterus. "These cases are always treated by burying five to seven platinum tubes, the walls of which are three-tenths of a millimetre thick, containing altogether not less than 120 millicuries of radium emanation. The tubes are maintained in position for twenty-four hours by gauze packing. The quantity of emanation used must vary somewhat with the size of the tumor, but it is found that the best results are not obtained if not less than 120 millicuries are used. This heavy dosage is, of course, somewhat of a drain on the resources of any radium institute." From a numerical list of the cases of malignant diseases of all varieties treated at the Institute it appears that thirty such cases previously deemed inoperable have been well for a period of two years or more. Radium has a very remarkable and rapid effect on certain local tumors. Lymphosarcoma disappears rapidly, but fresh tumors usually continue to arise in distant lymphatic glands. Glioma or gliosarcoma of the orbit disappears within a fortnight, but returns. Good results are obtained in some sarcomata, notably inoperable sarcoma of the superior maxilla. The local lesions of Paget's disease of the breasts, as a rule, clear up, but as the formation of secondary deposits in the breast and glands is to be expected, a radical operation should be advised. Individual secondary carcinomatous glands, if not too large, rapidly disappear if treated by burying radium tubes in their substance, but infection of glands at a distance commonly ensues. Another point made is that radium treatment may render operation possible, in carcinoma of the breast, of the bladder, of the cervix of the uterus, and for the removal of sarcomatous masses. Apart from all this, radium is of great use in relieving the discomfort of patients suffering from hopeless cancer. It is employed to relieve pain, heal ulceration, check discharges, stop bleeding, and thus to improve the general health of the patient. An appeal is made to the supporters of the Manchester Radium Institute to provide more suitable premises, and special beds for the treatment of cases in which it is thought desirable to bury tubes of radium emanation in the growths. Well lighted, well ventilated premises are very essential for the welfare of the radiologists and the nurses.

St. John, A. Crystal Structure of Ice. (*Nat. Acad. Sci., Proc.*, 4, pp. 193–197, July, 1918; from *General Physics*, Vol. XXI, p. 405.)

An account of a careful x-ray analysis of the structure of ice. Special precautions were taken to keep the ice in a perfectly dry condition and to prevent sublimation. When protected in the manner described specimens of ice crystals were preserved for days. Commercial artificial ice was first examined as it shows a marked prismatic structure. Unfortunately the prisms are distorted through pressure in the formation of the ice, so that it is difficult to identify cleavage planes. Measurements on carefully prepared ice crystals, however, show that ice is properly assigned to the hexagonal system; that it contains four interpenetrating triangular lattices, and that the fundamental spacings are: $a = 4{\cdot}74 \times 10^{-8}$ cm.; $h = 6{\cdot}65 \times 10^{-8}$ cm.; $d_{1120} = 3{\cdot}79 \times 10^{-8}$ cm.; $d_{1010} = 2{\cdot}37 \times 10^{-8}$ cm.; $d_{0001} = 3{\cdot}32 \times 10^{-8}$ cm.

"PROTACTINIUM," A NEW RADIO-ACTIVE ELEMENT

According to a note in the *Chemical Trade Journal* for June 29th, a new radio-active element of considerable emissive power has been detected in the residue from pitchblende, which forms the raw material employed as a source of radium. This residue was subjected to treatment which finally left undissolved only the members of the tantalum group; and this insoluble remainder showed a radiation, at first slight, but gradually increasing largely, which proceeded mainly from the evolution of actinium, and indicated the presence of the new element "protactinium." Experiments for the separation of the elements are to be undertaken. The period of semi-disintegration probably fluctuates between 1,200 and 18,000 years. The information is based on statements published in the *Münchner Neueste Nachrichten.—Nature.*

Radiology of Tuberculosis Suspects. (*Paris méd.*, Vol. 9, No. 5, Feb. 1, 1919; from *Jour. Am. Med. Assn.*, Vol. LXXII, No. 14.)

Delherm relates that among the 1,100 men suspected of tuberculosis and sent to his *centre de triage* for confirmation, 694 proved to be exempt from tuberculosis. Others have reported that 50 per cent of the suspects proved to be nontuberculous. Roentgen examination often turned the scale, the radiograms taken not only of the whole lung but of the suspicious points. Especially important is stereoscopy taken erect, in the course of the same apnea. When the apex looks suspicious, he leaves it and examines other parts of the lung, having the patient cough and breathe deep. Then when he returns to the apex he often finds that it has cleared up. Some people never aerate the apex fully. When the bronchi cast wide, pronounced shadows, usually bilateral, the presumption is in favor of ordinary bronchitis; with tuberculosis, with such findings there would be other signs of it in the lungs. With cancer of the lung, the subjacent lobe is clear, and the outline of echinococcus cysts is usually roundish and well defined. He has encountered one case of syphilis of the lung; the signs of infiltration under the right clavicle and positive physical findings were not accompanied by bacilli in the sputum, and rapid improvement followed specific treatment. After pleurisy, the base may look veiled, owing to symphysis, and the movements of the diaphragm may be hampered by adhesions, and the lung look gray in parts. The clearing up of the lung during respiration and coughing and the absence of foci of congestion in the subclavicular region are instructive. In other cases, however, nothing but the continued absence of tubercle bacilli from the sputum will finally exclude tuberculosis.

Radiotherapeutic Treatment of Local Hyperhidrosis with Hand Rays. (*Berliner klin. Woch.*, Dec. 30, 1918, from *Med. Rec.*, March 8, 1919.)

F. M. Meyer, after six years' work along these lines, believes that only hard radiations, greatly filtered, can surely cure hyperhidrosis. The dose of rays employed must vary with each case and it is well to proceed by repeated séances, each one of which should be made at a different area of the cutaneous surface under treatment. A cure requires considerable time, since destruction of the sudoriparous glands must be obtained. As to complications, an alopecia frequently results in the axilla and, besides, the skin offers a certain hardness with a tendency to fissuring. However, these untoward results are readily accepted by patients for the good results otherwise obtained.

Young, E. L. Clinical Diagnosis of Lithiasis of the Upper Urinary Tract. (*Jour. Am. Med. Assn.*, Vol. LXIX, No. 18.)

No single piece of evidence, or combination of evidence, is sufficient to make an absolute diagnosis of a renal or ureteral stone. All chance of mistake should be excluded by using ureter catheters, wax-tipped catheters, stereoscopic plates, and roentgenograms with injected pelvis.

In all cases with indefinite symptoms, such as recurrent or chronic pain in the abdomen or back, even when a definite orthopedic abnormality is present, careful, repeated examination of the urine should be made, including a microscopic examination of centrifuged sediment, regardless of the presence or absence of albumin. In the female, such examination

is of value only when the urine is obtained by catheter. Whenever operation is considered in any one of this group of cases, roentgenoscopy in addition to the foregoing examination is necessary.

Bugbee, H. G. Clinical Study of Lithiasis. (*Jour. Am. Med. Assn.*, Vol. LXIX, No. 18.)

Intestinal stasis is an important predisposing factor in the formation of urinary calculi. Urinary stasis and infection are immediate predisposing factors. Renal mobility plays an important rôle in this consideration.

Renal calculi may be single or multiple; small or large; unilateral or bilateral; located in the cortex, the pelvis or a calyx; or they may be branching, completely filling the cavity of the kidney.

Local symptoms may be absent, slight, or acute. Physical signs may be absent or definite. A diagnosis of the presence of a calculus should be made by cystoscopic and roentgenographic methods. Contact of the tip of a roentgen-ray bougie will verify the diagnosis in many cases of renal calculi, but may have to be supplemented by pyelograms, not only to locate exactly the stone in the kidney, but also to show the extent of kidney destruction. Data so obtained make it possible to outline the operative procedure which will result in a cure, and after-care may prevent recurrences.

Ureteral calculi are common. They may give rise to indefinite abdominal symptoms, or to typical colic. Fifty per cent of ureteral stones will pass; 75 per cent will be passed following intra-ureteral manipulation, which consists in dislodging the calculus and dilating the ureter below.

Vesical calculi are comparatively rare, owing to earlier diagnosis and the better treatment of vesical obstructions. When found, they are smaller than formerly, owing to the earlier diagnosis, and can often be removed by litholapaxy, unless a prostatectomy is necessary.

Prostatic calculi should be suspected in long-continued prostatic suppuration. They should be diagnosed early and removed by prostatectomy.

BOOK REVIEWS

Bernstein, Ralph, M.D. Ultra Violet Rays in Modern Dermatology.

In a small monogram of 162 pages the author presents the essential features of the history, the physiological effects, a detailed description of the Kromayer and Alpine lamp, and the therapeutic application of the ultra violet radiations in the treatment of affections of the skin.

The historical data and physiological effects of the ultra violet radiations are very briefly considered by the author, while a most liberal space is allotted to the description of the Kromayer and Alpine lamp.

The author's technique is based wholly upon the applications of this particular type of apparatus, which he evidently considers the only mechanical device suitable for this class of work.

Those who are using it may find the technique described by the author of this book of considerable value.

John H. Burch.

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OSTEOMYELITIS

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IN a normal long bone we have a medullary canal containing the blood supply, nerves, lymph vessels and marrow fat. Then we have the dense hard bone surrounding this which we call the cortex, this, in turn, being covered by a fibrous sheath, the periosteum; and at each end of the bone we have the joint surface, namely, a cartilaginous covering. Any one or all of these structures may be involved in an inflammatory process. When the periosteum is involved we have a periostitis; when the infection is confined to the cortex we have an osteitis; an infection of the medullary canal is a myelitis. The combination of diseased cortex and medullary canal we speak of as an osteomyelitis.

While the pyogenic factor may vary in bone infection, the process is the same, varying only as to the severity and duration of the infection. Before taking up the changes that occur, it is well to bear in mind just how the infection reaches the bone, as the roentgenological picture varies according to the point at which the infection starts. In a general way we may speak of four portals of entry:

1. Hemotogenous or lymphoid in origin.
2. Infection lodging beneath the periosteum.
3. Arising in the joint.
4. Direct inoculation, as in wounds and compound fractures.

In the first group, the blood or lymph supply carries the infection through the nutrient canal into the medullary portion of the bone; and since this is filled with the soft marrow fat the infection may spread easily and rapidly up and down the medullary canal. (Fig. 1.) In this condition the changes take place within the bone; the cortex and periosteum are not involved in the early stages.

When the infection lodges beneath the periosteum we have it and the bony cortex involved. (Figs. 2 and 3.) Since the cortex is quite dense, the infection is more or less limited and does not tend to spread; consequently in this type the medullary canal is not often involved, but we have an extensive periostitis and osteitis. (Fig. 4.)

When the infection starts in the joint we have extensive destruction of both articulating surfaces, and finally the disease breaks through one of the cartilaginous surfaces and destroys to a more or less degree the head of the bone, where cancellous bone is present; and here again the infection extends but slowly into the medullary canal proper. In compound fractures the infection is carried directly to the medullary canal and raw exposed

bony surfaces, so that periosteum, cortex and medullary canal may be involved simultaneously.

The question naturally arises, Does osteomyelitis give us a constant roentgenological picture? The answer must be "No"; but we may qualify our "no" by stating that the pathological process is the same and that if we understand the fundamental principles of bone infection, while the pictures may vary, yet one will recognize the condition.

There are only two changes that take place, namely, bone destruction and bone reproduction. It is the variation in these two processes upon which we make our diagnosis. We must remember that normal bone is pierced by numerous small Haversian canals and that these are in direct connection with the medullary canal. Now, an infection that starts in the medullary canal not only extends up and down, but also into the Haversian canals. If the infection is virulent we soon get evidence of bone destruction, confined at first to the Haversian canals, and finally by extending down these canals, the infection will completely surround a portion of bone, thus devitalizing it, and we have the formation of a sequestrum (Fig. 5). If the infection is virulent, this takes place rapidly, and the most marked changes are those of bone destruction with but little new bone formation. We must remember that new bone formation is a repair process and does not take place until nature is getting the mastery of the infection. We must also bear in mind that in the very early stage of even a virulent bone infection the bone may be perfectly normal in

FIG. 1. INFECTION STARTING IN THE MEDULLARY CAVITY. NOTE PERIOSTEAL BRIDGE AND NEW BONE.

FIG. 2. SHOWS DENSE CORTICAL BONE, DUE TO INFECTION BENEATH PERIOSTEUM.

appearance upon the roentgen-ray plate, but at operation we shall find the little canals that traverse the bony structure completely filled with pus. No bone destruction has as yet taken place, and consequently the roentgen-ray plate will be negative. Such a case examined a few days later will show beginning destruction. Care must be taken not to mislead the surgeon in such a case by reporting a negative plate.

Fig. 3. Acute Infection Beneath Periosteum. Cortex destroyed. Medullary cavity intact.

In an acute osteomyelitis we get the following picture upon a roentgen ray plate. The infection, having lodged in the medullary cavity, takes the path of least resistance and extends along the medullary cavity, and we get vacuolated spaces represented by areas of lessened density. The infection now spreads to the bony cortex and travels irregularly by means of the little bony canals, so that we may have areas of bone destruction with normal bone in between, and eventually these areas of normal bone will become cut off and form sequestra. This is an important point of differential diagnosis, because every pathological process in bone must be viewed as a possible malignancy until proved otherwise. Malignancy in long bones starts from one central point and radiates equally in all directions, absorbing the bone as the growth advances, but never appears as separate areas with normal bone in between.

Fig. 4. Infection Arising in Joint, Then Involving the Heads of All Three Bones.

The osteomyelitis infection will finally pierce the cortex in one or more places, leaving areas of normal cortex in between. Here again we have another important point of differential diagnosis, as in malignancy when the growth reaches the cortex it destroys it completely as a whole, and not in parts, as osteomyelitis does.

Thus far we have been discussing the acute destructive process; but with the piercing of the cortex and the acquired resistance of the tissues, nature now attempts to limit the destructive processes, and this is done by building up a new bony wall at the edge of the infection. To produce bone reaction there must be a stimulation, and the point of stimulation is always at the point where the infection stops and the normal bone begins; so we must look for our new bone production at the edges of the infection and not in the middle of it. The result of this will be that the new bone laid down will follow the edge of the infection. This gives us a varied picture, as the destruction will determine where the new bone will be laid down.

FIG. 5. VIRULENT INFECTION SHOWING EXTENSIVE DESTRUCTION AND VERY LITTLE BONE PRODUCTION.

At the same time, the infection having reached the periosteum, we shall find extensive periosteal bone following, of course, the periosteum. This deposit of periosteal bone will frequently be sufficiently great to give the appearance of expansion of the bone. Close inspection, however, will reveal that the apparent expansion is in reality due to deposition of bone on the outside. This too, is an important point, as benign growths of the bone, such as cysts and osteochondromata, invariably expand the cortex, while osteomyelitis does not.

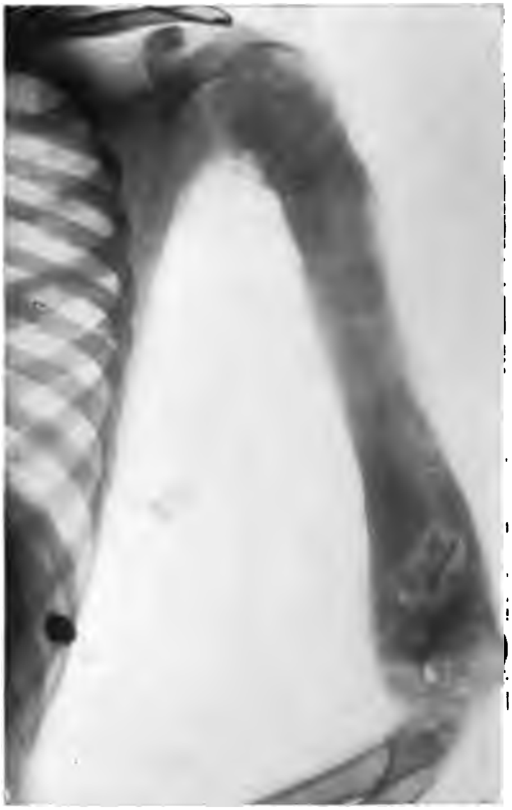

FIG. 6. ENORMOUS PRODUCTION OF DENSE BONE, MEDULLARY CANAL OBLITERATED, SEQUESTRUM AT LOWER END.

The predominating feature in acute osteomyelitis is bone destruction with but little new bone production. In chronic osteomyelitis the conditions are exactly reversed. We have excessive bone reproduction with a few small areas of destruction. The entire bone is thickened, frequently to such an extent that the medullary cavity seems to be completely obliterated (Fig. 6). The bone is often irregular in shape and much thickened, due to extensive deposition of periosteal bone upon the cortex. In the bone there may be

small areas due to little focal spots of infection. From this brief description it will be readily seen that we have no one definite roentgen ray picture, but that the changes will depend entirely upon the virulence of the infection, the stage of the disease and the resistance of the patient. The following points must always be carefully noted:

1. The place where the infection starts.
2. The character of the destructive process.

FIG. 7. ENTIRE SHAFT IS A SEQUESTRUM, DENSE NEW BONE FORMING INVOLUCRUM. NOW READY TO BE OPERATED UPON.

3. The path of extension, that is, spreading equally in all directions or following the path of least resistance.
4. The character and situation of new bone production.
5. The condition of the cortex, whether it is intact, destroyed as a whole or pierced by sinuses, expanded or not.

Thus far we have discussed only the infections arising from pyogenic organisms. We have one infection of constitutional origin which is extremely common, namely, luetic osteomyelitis. In this condition the changes are frequently identical with those of pyogenic origin. There are two points, however, that assist us in making a correct diagnosis. First, the lesions are generally observed in more than one bone; and second, the clinical picture does not coincide with that given by the roentgen ray. In lues the plate may show an apparently very acute osteomyelitis, evidenced by extensive destruction, the entire bone being involved, yet there will be but few clinical symptoms.

A careful study of the plate will give not only a correct diagnosis but it gives further information to the surgeon. It not only tells the extent of the disease, and the presence or absence of sequestra, but it also determines the presence or absence of an involucrum (Fig. 7). This is of great importance, as it frequently determines the character of the operation necessary. For example, in an acute osteomyelitis, where practically the entire bone is involved, it will be necessary to take away all the diseased bone to cure the patient. Now if the plates show that no involucrum has formed, the surgeon will confine himself to opening the bone to get free drainage and will do the radical operation later, after the involucrum has formed.

We have emphasized the fact that our diagnosis is based upon bone destruction and production, arising from infection. If any other cause has been added to the infection, particularly surgical interference, we may draw erroneous conclusions, because our apparent bone destruction may not be due to disease but may be the result of the surgeon's curette; and furthermore, our new bone production may take place in the normal bone through which the surgeon passed to reach the infection. It is always well to know beforehand in any bone lesion whether there has been surgical interference. One should always be extremely guarded in giving a diagnosis in such a case.

COEXISTING MULTIPLE LESIONS AS CAUSES OF DIAGNOSTIC ERRORS OF OMISSION *

BY A. W. CRANE, M.D.

KALAMAZOO, MICH.

GENERAL usage has sanctioned the terms clinical diagnosis, physical diagnosis, laboratory diagnosis and *x*-ray or roentgen diagnosis. Usage overrides every other consideration and these terms are not likely to be discontinued. They both reflect and mould current conceptions of diagnosis. The idea largely prevails that the pathologic process from which the patient suffers may be investigated by these several methods and thus the diagnosis formulated from symptoms may be confirmed by physical signs, laboratory procedures or roentgen ray methods. Many clinicians from pride of craft habitually confine their diagnostic inquiries mostly to histories, symptoms and physical signs. But the roentgen diagnostician is equally at fault in presenting and emphasizing diagnoses made exclusively by the roentgen rays. Thus we learn to expect a diagnosis to be stated in single terms, viz., pulmonary tuberculosis, duodenal ulcer, gallstones, etc.

An eminent clinician and teacher in one of our great medical schools has stated recently: "There is a general diagnostic law which it is well to hold to in any case, and that is, but one pathologic process ever assails an individual. To be sure, such a pathologic process may have several associated and secondary conditions growing out of the primary one; but the general rule holds true."[1] As we read his clinics we are more than half convinced by the brilliant analysis of each case and the unrivaled synthesis whereby the diagnosis is clearly and inevitably constructed before our eyes out of symptoms pure and undefiled by either a gastric analysis or a roentgen ray plate.

If it were true that a patient never had but a single disease at a time, then any single method of diagnosis which detected this disease would be sufficient. Thus the symptoms and history alone may be sufficient in a case of gallstone colics, physical signs alone may be sufficient for a valvular disease of the heart, the laboratory examination alone sufficient for a pernicious anemia and the roentgen rays alone for a vesical calculus. A clean-cut diagnosis, such as a pulmonary abscess, a gastric ulcer or a nephritis, which explains symptoms will commonly be accepted as a proper basis for treatment, medical or surgical, and further diagnostic investigation be deemed unnecessary.

It is the burden of this paper to show that a single pathologic process is not the rule in chronic cases and that the true diagnostic concept is not a demonstration of a single lesion, although it may be the lesion which causes the symptoms, but a demonstration of every pathologic process or condition that can be found in the case. Single methods of examination cannot be relied upon no matter how skillfully employed. All must be practiced. This is too obvious to require examples. Multiple lesions are found in more than 50 per cent of cases and many failures of treatment are due to undiscovered lesions whose presence and influence may be overlaid and overshadowed by a more demonstrative process.

These conclusions were reached by a review of 781 recent cases examined in collaboration with my partner, Dr. John B. Jackson, in which the case records cover symptoms, physical signs, laboratory findings and roentgen ray studies. We have classified these cases as follows:

(1) Those having a single pathologic process present:

Number, 386 Per cent, 49

[1] *Medical Clinics of Chicago*, Vol. II, No. 4, January, 1917, pp. 787–788.

* Read at the Nineteenth Annual Meeting of the American Roentgen Ray Society, September, 1918.

(2) Those having two or more pathologic processes present:

Number, 395 Per cent, 51

We may consider that for our series the two classes are each 50 per cent. If our examinations had been sufficiently searching it is probable that the percentage of single lesions would have been still further reduced. On the contrary, if our analysis of each case had been made with sufficient knowledge and discernment, it is equally probable that many apparently separate lesions would have been found to be in reality related effects of a single pathologic process.

Our first division of cases showing a single pathologic process may be subdivided into (*a*) 338 cases having a single organ affected, as for example pulmonary tuberculosis; and (*b*) 48 cases having two or more organs affected, as for example pulmonary tuberculosis and renal tuberculosis in the same patient, or arthritis and endocarditis, etc. These latter are coexisting multiple lesions but would not violate the dictum quoted at the beginning of our thesis.

The 395 cases of multiple lesions which do confute this dictum may be subdivided into (*a*) 122 cases having several diseases which form chains of cause and effect, and (*b*) 273 cases which have two or more unrelated diseases forming true multiple lesions.

Table

Compilation from Case Records	No. of Cases	Per Cent
1. Single pathologic processes	386	49
(*a*) affecting single organs	338	43
(*b*) affecting several organs	48	06
2. Multiple pathologic processes	395	51
(*a*) In chains of cause and effect	122	16
(*b*) Unrelated	273	35

It is obvious that the more chronic the case the more probable is the existence of multiple lesions. Nevertheless acute diseases may be multiple, as for example pneumonia in the course of influenza, the two diseases having distinct etiologies. Gonorrhea and syphilis may coexist. Typhoid and malaria, though rare, have been demonstrated in the same patient. An acute may be grafted upon a chronic disease. The writer had a case of pulmonary tuberculosis with tubercle bacilli in the sputum who exhibited periodic paroxysms of the malarial type. This would seem consistent with the usual septic complications of tuberculosis. But we were able to demonstrate the plasmodium in the blood, and the blood findings were verified by Dr. George Dock, at that time professor of medicine at Michigan University.

Cases showing a single pathologic process affecting several organs are to our surprise much the least numerous of our series. The distinctions between a single disease affecting several organs and a chain affecting several organs may be absent in some cases. A pyorrhea with an endocarditis and an arthritis may be considered in either class. Where they coexist we have classified them as a single disease affecting different organs.

If, however, an appendicitis leads by reflex action to gastric hyperacidity and ulcer, this is clearly a chain. Coexisting multiple diseases in chains of cause and effect are among the most interesting of our series. Chains of this sort may be of considerable length and somewhat theoretical.

Such a chain is seen in gallstones with diabetes. The initial lesion may have been a typhoid fever causing a cholecystitis. From the cholecystitis result gallstones. As is well known, living typhoid bacilli have been grown from the nuclei of gallstones. From an impacted stone in the common duct result a temporary occlusion of the pancreatic duct with the production of a low grade pancreatitis and ultimately a diabetes from a disturbance of the internal secretion of the pancreas, as shown by Opie many years ago. As a predisposition of the diabetes, pulmonary tuberculosis may supervene or it may be a gangrene or yet a destructive lesion of the phalanges of the big toe. The roentgenologist may find himself in on the case because of the gallstones, or the pul-

monary complication, or perhaps because of the necrosis of a bone in one toe. If a diagnosis were attempted without a survey of the case it is easy to see how misleading might be the apparent indications for treatment.

The diagnostic chain may connect other organs in quite a different direction. The gallstones which may have resulted from other causes than typhoid fever may by a well-known reflex effect disturb the gastric secretions, setting up a gastric hyperacidity. Sooner or later in a certain proportion of cases there arises a duodenal ulcer. We will not say that the hyperacidity causes the ulcer. It is indeed surprising to see how many causes of peptic ulcer have actually been demonstrated and how various are the opinions of able clinicians concerning the causation of ulcer. But it is beyond dispute that the overwhelming majority of ulcers are associated with hyperacidity, so that our diagnostic chain remains unbroken whatever may be the nature of the intermediate links. To treat the ulcer either medically or surgically without reference to the gall bladder is obviously illogical.

Again, the gallstones may be finally associated with the cancer of the gall ducts and liver and lead to carcinoma of the lungs. In one of our cases the pulmonary metastasis was present at an early stage, and was the deciding factor against operation for the gallstones. In another case, although gallstones showed clearly on the roentgen plates, a carcinoma of the stomach was also demonstrated which materially altered the original surgical program.

A diagnostic chain which closely concerns the roentgenologist at present begins with dental sepsis as shown on tooth films, and may result in several simultaneous lesions such as an arthritis, a cardiac valvular lesion and a nephritis. Of the forms of arthritis thus caused we may especially mention spondylitis deformans because of the frequency with which the pains of this affection are mistaken for those of thoracic, abdominal or renal diseases. The septic focus may be a tonsil, an infected sinus, a salpingitis, etc., and the secondary lesion may involve any organ of the body.

In old chronic cases the diagnostic chain once perfect may have become broken and some of the links missing. The teeth may all have been extracted and the arthritis may be merely a matter of an indefinite case-history, and yet the nephritis may remain as a net result associated with a cardiac murmur marking the former endocarditis, and with a rising blood pressure by which nature is attempting to compensate for the contracting kidneys. Again, an appendix which had been the seat of repeated inflammation may have become obliterated or removed by operation, and yet the chronic dyspepsia which was initiated as an appendiceal pylorospasm may remain.

When the list of disease entities in any case contained two or more which could not be logically connected in the chain of cause and effect, then the case was classified under the head of coexisting pathologic processes. This was the classification even though a chain were also present. This class constituted 35 per cent. The grouping of diseases follows no rule whatever. The variety is infinite. The lesions may be silent and quiescent or active and symptom-producing. The disease entities listed included not only diseases such as gastric ulcer, cholecystitis, epilepsy, but also such conditions as hernia, gastroenteroptosis, laceration of the cervix, scoliosis, etc.

Vascular hypertension occurring by itself is put down as a diagnosis, but when occurring with nephritis is considered as a symptom or secondary effect. The justification of this ruling is that when vascular hypertension is the only visible factor it may be named to designate the pathologic process. The same rule applies to anemia, hyperacidity, etc., which are secondary to many conditions. It may at times be questionable whether or not the hyper-

tension, etc., are primary causes in themselves.

We have classified gastritis with hyperacidity and duodenal ulcer as multiple lesions affecting two organs but it is easy to see that this might not be the classification of one who was guided by the fact that the bulbus duodeni is embyryologically a part of the stomach.

The number of coexisting pathologic conditions in some cases may at first excite amusement and incredulity in the minds of those accustomed to think of a diagnosis as a single pathological entity. Examples from our files are as follows:

Mr. L.
Chief Complaints
(1) Cough
(2) Epigastric pain
(3) Dysuria
Diagnostic Findings
(1) Pulmonary tuberculosis
(2) Dilatation of aorta
(3) Prostatic hypertrophy
(4) Gastric hyperacidity
(5) Duodenal ulcer
(6) Chronic appendicitis
(7) Anemia

Mrs. T.
Chief Complaints
(1) Melena
(2) Headaches
(3) Abdominal soreness
Diagnostic Findings
(1) Gallstones
(2) Hyperacidity
(3) Anemia
(4) Goiter
(5) Migraine
(6) Endocervicitis
(7) Pruritus vulvæ

Mrs. D.
Chief Complaints
(1) Left hypochondriac pain
(2) Tumor
Diagnostic Findings
(1) Hydronephrosis
(2) Mitral regurgitation
(3) Aortic aneurysm
(4) Vascular hypertension
(5) Myocarditis
(6) Achylia gastrica

Mrs. P.
Chief Complaints
(1) Epigastric pain
(2) Abdominal soreness
Diagnostic Findings
(1) Cholecystitis
(2) Gastric hyperacidity
(3) Pelvic inflammation
(4) Anemia
(5) Pyorrhea
(6) Vascular hypertension

Mrs. B.
Chief Complaints
(1) Right hypochondriac pain
Diagnostic Findings
(1) Renal calculus
(2) Cholecystitis
(3) Gastroenteroptosis
(4) Cystic kidney
(5) Gastric hyperacidity
(6) Anemia

Mrs. M.
Chief Complaints
(1) Dizziness
(2) Abdominal pain
(3) Constipation
Diagnostic Findings
(1) Cerebral syphilis
(2) Aortic dilatation
(3) Visceroptosis
(4) Gastric hyperacidity
(5) Cholecystitis
(6) Laceration of perineum
(7) Hemorrhoids

Miss I.
Chief Complaints
(1) Headache
(2) Unconsciousness
(3) Vertigo
Diagnostic Findings
(1) Epilepsy
(2) Migraine

(3) Tonsillitis
(4) Dental sepsis
(5) Anemia
(6) Sciatica

Mr. W.
Chief Complaints
(1) Epigastric pain
(2) Jaundice
(3) Dyspepsia
Diagnostic Findings
(1) Mitral regurgitation
(2) Prostatic hypertrophy
(3) Pancreatitis
(4) Gallstones
(5) Colonic stasis
(6) Pyorrhea

These are the most extreme examples which we could select. Shorter groups are the rule, such as:

Mrs. L.
Chief Complaints
(1) Dyspnea
(2) Nervousness
Diagnostic Findings
(1) Hyperthyroidism
(2) Pelvic tumor
(3) Vascular hypertension
(4) Pyorrhea

Mrs. B.
Chief Complaints
(1) Epigastric pain
(2) Pelvic pain
(3) Dysphagia
(4) Menorrhagia
(5) Leg pain
Diagnostic Findings
(1) Gastric hyperacidity
(2) Appendicitis—chronic
(3) Fibroid uterus

Mr. C.
Chief Complaints
(1) Dysphagia
(2) Nervousness
Diagnostic Findings
(1) Carcinoma of esophagus
(2) Hypertension
(3) Nephritis

Mr. S.
Chief Complaints
(1) Thoracic pain
Diagnostic Findings
(1) Angina pectoris
(2) Achylia gastrica
(3) Appendicitis

Mrs. H.
Chief Complaints
(1) Menorrhagia
(2) Headache
Diagnostic Findings
(1) Uterine fibroid
(2) Chronic appendicitis
(3) Laceration of perineum and cervix

Mr. M. C.
Chief Complaints
(1) Loss in weight
(2) Weakness
(3) Nausea
(4) Vomiting
(5) Constipation
(6) Abdominal pain
Diagnostic Findings
(1) Gallstones
(2) Duodenal obstruction
(3) Syphilis of the lungs

Mrs. J.
Chief Complaints
(1) Abdominal pain
(2) Gas eructation
(3) Lumbar pain
(4) Loss in weight
Diagnostic Findings
(1) Appendicitis
(2) Salpingitis

Mr. L.
Chief Complaints
(1) Dyspnea
(2) Epigastric pain
(3) Cough
(4) Weakness
(5) Loss of weight
Diagnostic Findings
(1) Duodenal ulcer
(2) Aortic regurgitation
(3) Chronic interstitial nephritis

Although a fair proportion of our surgical cases underwent operation, yet the majority were subjected neither to operation nor autopsy. While this is unfortunate for diagnostic figures, as a matter of vital statistics it will not be criticized by patients. However, the statistical use of our case records for the purpose of this study is not subject to a material factor of error. Much of the diagnostic data is not susceptible to operative or postmortem findings, as for example the degree of gastric acidity, the blood pressure, the degree of anemia or leucocytosis, gastric or intestinal peristalsis or motility, albuminurias, indicanuria, renal inefficiency, uremia, epilepsy, diabetes, paralyses, hyperthyroidism, etc. Other diagnoses are quite as certain before death as after autopsy, such as hernia, spinal curvature, spondylitic deformans, lacerations or displacements, pulmonary or renal tuberculosis, fistula, urinary infections or bacteriological demonstrations in general. The roentgen ray study may equal the autopsy in certain particulars, such as gastroenteroptosis, enlargement of the heart, the distribution of pulmonary deposits, the presence of fluids and air in the pleural sac, etc.; and it may excel the operative findings in some cases of cancer of the stomach, duodenal ulcer, diverticulæ, esophageal structure or obstruction at the cardia, etc. In conjunction with cystoscopic methods the roentgen ray leaves little about the renal tract for the surgeon to discover.

These lists are illustrative, not exhaustive. They help to show that the substantial accuracy of our statistics are dependent to a limited extent only on operative and postmortem findings, which nevertheless we greatly value. While the general conclusions of this paper would not be altered by any but large percentage errors, their truth is best established by cases taken as they come in the file without selection.

Our purpose is to classify the experiences which lead us to the conviction that in a large proportion of cases multiple pathologic processes do coexist and that an important factor of error does result from the failure to examine patients fully by combined methods of diagnosis.

NOTES ON THE ROENTGEN RAY WORK OF AN OVERSEAS HOSPITAL

BY CHARLES EASTMOND

Lieut. M. C., U. S. N. R. F.

BROOKLYN, N. Y.

My roentgenological experience abroad was in connection with Navy Base Hospital Unit No. 1. This Unit went over under orders as the Base Hospital for the Marine Brigade, and the equipment taken was all of the Base Hospital type; that is to say, there was supplied an interrupterless transformer of standard type with horizontal and vertical fluoroscopes, a vertical plate changer and a standard type tube stand. We took our own sheet lead, darkroom fittings, tubes, etc., so our equipment was ample for any type of work which would be required. The electric current supply was such that it was readily adapted to the apparatus.

As there was no Marine Brigade at the time of our arrival in the first part of October, 1917, we were transferred to the Army, and consequently became an Army Base Hospital, and were stationed at Brest. As such, we recruited patients from the stevedore regiments working on the docks, and also from such detachments as were stationed in the neighborhood. The most important work, however, was as a Debarkation Hospital, as such receiving the sick from the transports.

So far as equipment was concerned, it was adequate. Shortage of mechanics in the enlisted personnel necessitated that the medical officer should be his own mechanic and the assembling of the apparatus, construction of aërials and general equipping fell under his direction.

Because of the location of the hospital and the character of the patients received, the work was primarily medical. Until the middle of April, 1918, when I was detached, no wounded had been received, and consequently no experience was gained with localization of foreign bodies or gunshot injuries. The work as a whole was that of a civilian hospital at home.

Occasional accidents with associated fractures or dislocations, an infrequent case of bone infection, with a few gastrointestinal cases, comprised the minor part of the work, while the major part was associated with respiratory diseases and their complications.

Every pneumonia convalescent suspected of pleuritic complications was roentgen rayed. In this way a large number of cases of pleuritis were picked up in the earliest stages. Our experience with empyema during this period was, as has been the case in a majority of army hospitals on this side, that fully one-half of the cases are sacculated, and that cases of multiple sacculation were not uncommon.

The roentgen ray examination in these cases proved to be of the greatest assistance, especially in regard to determining the site of operation. A point of importance in this connection, and one that I believe has not been mentioned, is that in a case of sacculated empyema, especially of the more common type located along the outer margin of the chest wall, the dense shadow observed on the screen or plate marks the limit of *pleural* involvement, but is not an indication of the extent of the contained fluid. Our experience was that in this class of cases the fluid does not extend to the lower limit of the dense shadow, but that it ends at a point about one inch above it and that the lower part of the shadow is due to thickened pleura alone. This observation was confirmed many times at operation.

As the *x*-ray room was located next to the operating room, the rib resection or other surgical procedure was often carried out on the fluoroscopic table. Observation was here made that upon evacuation of the pus there is but slight change in the density of the affected area as viewed on the fluoroscopic screen, and that the shadow does not diminish to any degree for several days.

Another series of observations carried out in connection with the empyema cases was a study of the diaphragm on the affected side. It was the writer's observation that with the presence of fluid in the chest, the diaphragm movement on the affected side is practically abolished and that it does not return until there is a complete closure of the surgical thoracic opening. This, of course, applies to those cases in which lung expansion is free and there are no marked adhesions consequent to the infection. This practical abolition of diaphragmatic movement seemed to be present in the sacculated cases, as well as in the cases of free fluid. Location seemed to make but slight difference. In two cases of pus at the apex of the lung, the diaphragm movement was so diminished as to be indistinguishable on the screen. In one case, however, where pus was in the posterior mediastinum, no diaphragmatic alteration was observed.

In concluding these desultory remarks, the writer again wishes to emphasize: (1) that in operating in cases of empyema, the surgeon should make the incision at least one inch above the lower limit of the shadow in the sacculated cases, and (2) that diaphragm movement is practically abolished in the presence of fluid in the chest, even though it be sacculated, and that its function is not restored until there is a complete closure of the chest with full lung expansion on the affected side.

FAMILIAL DEFORMING CHONDRODYSPLASIA MULTIPLE EXOSTOSES*

BY C. S. GORSLINE, A.B., M.D.

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IT has been my good fortune in the past year to have two groups of cases presenting certain skeletal deformities come to my laboratory for roentgenological study. These cases were so interesting and presented so many points in common, that I felt obliged to look up any literature which might throw light upon the subject. To my great regret I was unable to find any detailed report of cases of this type by an American roentgenologist. In fact the most able and authoritative article was published by a surgeon, Dr. Albert Ehrenfried of Boston, in the *Journal of the American Medical Association*, Feb. 17, 1917; and something will have been accomplished if the attention of roentgen ray specialists can be engaged along this line, so that more cases, well studied, are reported, thereby forming a broader basis upon which reliable deductions may be founded.

As to the literature hitherto published regarding skeletal deformities of this type, I can do no better than refer to the above mentioned article by Dr. Ehrenfried, as he has covered the ground very ably. I agree with him that what has been held to be a condition of rare occurrence is really more common than hitherto supposed. In the light of recent study, I realize that I have overlooked in my roentgenological practice many interesting groups of cases where the roentgenogram accidentally revealed abnormalities of bone structure, which would have yielded much interesting information if I had made diligent inquiry as to history and heredity. A. Render and P. Levy have an article in the *Lyon Chirurgical Journal*, August, 1914, on "Multiple Bony Exostoses with Arrest of Development and Deformity of the Skeleton"; also in May, 1917, D. M. Cowie gave a paper on "Hereditary Multiple Exostoses" before the American Pediatric Society; and the London *Lancet* for September, 1915, No. 4804, has an article by R. Cox entitled "Case of Multiple Exostoses with Hereditary History." No work on surgery to which I have access, gives more than a brief mention of the condition; but MacCallum's "Textbook of Pathology," page 882, under the subject of bone tumors, reads as follows:

"More difficult to interpret properly are the multiple exostoses which appear about the epiphysis in young persons and are left along the shaft as the bone grows. They are often partly cartilaginous for a time, but in the end are bony. They stretch for some distance and sometimes interarticulate, in a way, with one another, or by fusing limit the motion of the extremities. These growths are often observed to occur in one family, and seem to have a hereditary element."

As a preliminary contribution, I wish to report a series of four cases with such histories as were obtainable. These cases come from two familial groups.

CASE I, FIRST GROUP. MR. D. M.
(Figs. 1, 2 and 3.)

American born, probably of Scotch ancestry; age 67; height about five feet four inches; weight 127 pounds. His history is negative so far as disease is concerned and he was reared amid good surroundings with no history of rickets.

His mother first noticed his bony growths when he was four years old, and he said they continued to enlarge until he stopped developing at about 20 years. He always enjoyed good health and never had a fracture of any of his bones, notwithstanding the fact that he herded cattle two years in the West and spent most of his

* Thesis presented with application for membership in the American Roentgen Ray Society, 1918.

time on horseback. Later he became a manufacturer. He was very sensitive about his condition, and I discovered the abnormality while adjusting an armband preparatory to taking his blood pressure, which was 175 systolic. There was marked arteriosclerosis. It was for the symptoms of this condition that he consulted me, and he died of hemiplegia about one year later at the age of 68.

He had three sisters and five half-brothers, the latter children of his father's previous marriage. One sister and all of the half-brothers had abnormal bony growths, as did his father and paternal grandfather. Farther back than this he could not state.

Fig. 1.

He had the impression that those mentioned were affected mostly in the extremities.

He had two daughters, both married. One of these daughters has exostoses on the left femur, the left tibia and the right wrist, whether arising from the radius or ulna I cannot state. This daughter has two girls aged three and two, who so far have shown no evidence of the abnormality, according to the mother's report. The other daughter, who is normal, has one child less than a year old, who so far manifests no skeletal deformities. In Mr. D. M.'s case the deforming growths were large cauliflower masses chiefly affecting the long bones. I roentgenographed three of the more prominent of these growths.

Fig. 2.

Fig. 1 is of the right limb below the knee, the growth being on the inner aspect of the knee. In the single plate it appears as one mass, but stereoscopically it shows two

Fig. 3.

masses, one having its origin from the tibia and one from the fibula, but fusing when the development of the masses caused

impingement one upon the other. Other bony irregularities may be seen above and below the main masses. Fig. 2 shows a somewhat similar growth on the outer aspect of the right humerus. Fig. 3 is from the outside of the right femur. Another growth, which I did not ray, was present on the sternum. The patient told me he had never experienced the slightest discomfort from these tumors except from their size, but it could be plainly seen from his gait and posture that they interfered with the normal movements of the extremities.

These growths are cauliflower-like masses the size of an orange, having a definite stem or pedicle, and appear to arise from the cortex of the bone. The center of the bulbous portion is apparently as hard as ivory, while at the periphery it is less dense. They are not easily fractured because, though situated in an exposed position, only once in a lifetime was there ever a piece broken off, that being a small fragment of the growth from the right humerus, shown in Fig. 2. In the light of later study I am confident a more extensive examination would have revealed many more exostoses, as the forearms had the distortion peculiar to many of these cases. We have then a condition appearing in four successive generations, the fifth generation being still too young to be otherwise than negative.

CASE II, SECOND GROUP. MR. L. F. (Figs. 4, 5, 6, 7, 8)

American born, of Irish ancestry; age 64; married; six children, three girls, M., aged 22, C., aged 20, and A., aged 18 years; and three boys, L., aged 16, E., aged 14, and R., aged 11 years. Three of these six children, C., A. and R., show skeletal abnormalities. The eldest of the girls, M., is married but has no children, so that inheritance through her is undecided. Two of the boys, L. and E., are reported to be negative, but have not been roentgenographed.

Mr. L. F., Case II, says he may have had rickets when a child, but I am of the opinion this is more a matter of suggestion than actual knowledge of his condition. He cannot remember that he was ever sick in his life. He is quite sure his mother was normal, but knows little about his father. He has only one sister, who so far as he knows is normal; but this sister's daughter, who is 20 years old, has bony abnormalities of the left leg below the knee and of the left wrist. Mr. L. F. has marked deformities of both forearms, due to distortion of the shafts of the bones, which are badly deformed, as well as to the exostoses at both ends as shown in Figs. 4 and 5.

The left radius (Fig. 4) is short, thick and curved outward. It is greatly enlarged at the distal end, which carries all of the articulation of the hand to the wrist, as the ulna is too short to enter into its usual relationship to the hand. This gives the hand a characteristic swing to the ulnar side. There is a small tubercle on the head of the radius. The left ulna is exceedingly heavy at its proximal end, the shaft is somewhat thicker and shorter than normal and has its only articulation at the distal end by a pronounced lateral union with the enlarged distal end of the radius. Furthermore, about 2½ inches from the distal end, there is a very sharp bend laterally toward the radius to such an extent that only when viewed stereoscopically can it be determined that it does not make another articulation or fusion with the radial shaft. No history of fracture is obtainable.

The right radius (Fig. 5) is somewhat longer and straighter, also heavier, than the left, with an even more pronounced enlargement of the distal end. Like the left, it carries all the carpal articulations giving the hand the same lateral swing. The right ulna is short, smaller than the left and fairly straight. It does not make the usual joint with the carpals, but is articulated to the side of the much enlarged distal end of the radius. What should be the styloid process is very broad and heavy. The proximal end is abnormally heavy,

though not so deformed as that of the left. The wrists and fingers are freely movable and reasonably strong.

The femur above each knee, as well as the tibia and fibula below (Fig. 6), all show outgrowths of bone, but not to the extent exhibited in Case I. These enlargements vary in shape from large blunt tubercles to sharp pointed, usually curved spurs or spicules which invariably point away from the nearest joint, and do not present a surface deformity in proportion to the size of the growth beneath.

Fig. 4.

Fig. 5.

This case also has a large growth, which is about twice the size of an English walnut, arising from the posterior surface of the left ileum just below its crest; and on the posterior border of the left scapula there is a flattened growth about 2½ inches in diameter arising from the inner surface of the scapula, growing out from under it, and lying close down upon the ribs, as shown by stereoscopic roentgenograms. This scapular growth has a peculiar flaky appearance, as of minute particles of very dense bone in a more rarified stroma, which I have not found in any of the other exostoses. These two are the only instances in which flat bones are involved and they are of the cauliflower type, resembling those on the extremities of Case I. These conditions are poorly shown in Figs. 7 and 8.

CASE III, MISS A. F., EIGHTEEN-YEAR-OLD DAUGHTER OF CASE II.

(Figs. 9, 10 and 11.)

The forearms (Fig. 9) present some of the deformities found in the father, but not so marked. The right radius and ulna are not shortened, but are thickened and rather more curved than normal, and the ulna, being short, articulates with the radius only. It has no styloid process. Exostoses appear on the second phalanx of the right middle finger.

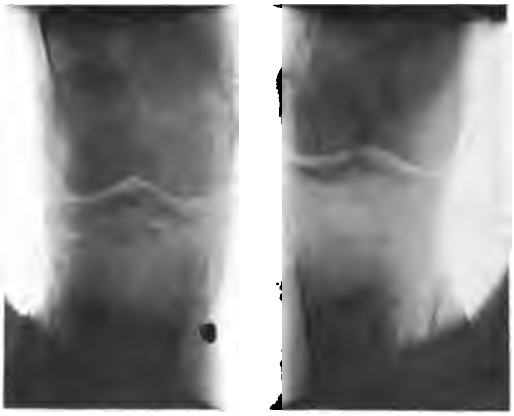

Fig. 6.

The left radius has a greatly enlarged distal end which articulates laterally with the ulna, but the ulna is long enough to assume its proper relation with the carpal bones. Slight exostoses are seen on some

of the phalanges of the left hand. The condition above and below the knee joints (Fig. 10) is more exaggerated than in Case II. The right tibia just above the ankle is greatly deformed by an enormous nodular growth on the anterior surface and a smaller one posteriorly, which again is of the cauliflower type. As this prohibits the lacing of the shoe, I hope it will be removed in the near future. The lower end of the right fibula also shows a posterior spur.

CASE IV, R. F., ELEVEN-YEAR-OLD SON OF CASE II.

(Figs. 12 and 13.)

Here the deformity of the wrists is still less marked, but the tendency to spur form-

FIG. 7.

ation is more emphatic, and there is a considerable outward bend in the right radius with sharp curved spurs, one on each lateral aspect of the bone. The ulna is straight, but shorter than normal, with a tendency to articulate with the radius more than with the carpals. The epiphyses of both bones are distinct and somewhat wedge-shaped. The left ulna is fairly normal as to shape, length and epiphysis, but the left radius is bent outward and has a sharp spur on its lateral aspect. Certain of the phalanges and metacarpals of the left hand show beginning exostoses. Both knees show even at this early age very pronounced exostoses, of the nodular and long spur types, together with great thickening of the heads of the fibulæ. These appear to fuse with the heads of the tibiæ. Each fibula, however, has a distinct epiphysis at the upper end. None of the epiphyses entering the knee joint formation are ab-

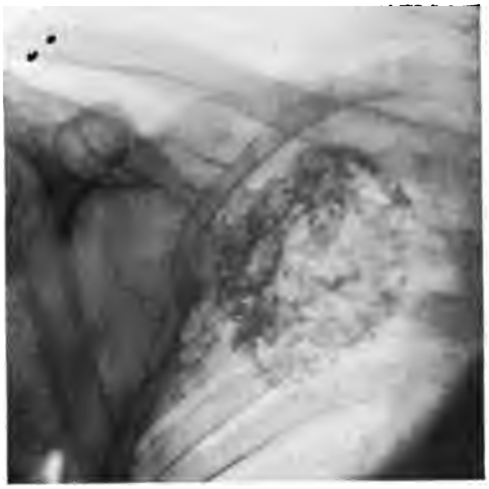

FIG. 8.

normal. If these exostoses continue to grow according to their early promise there will be great deformity of these joints before development ceases.

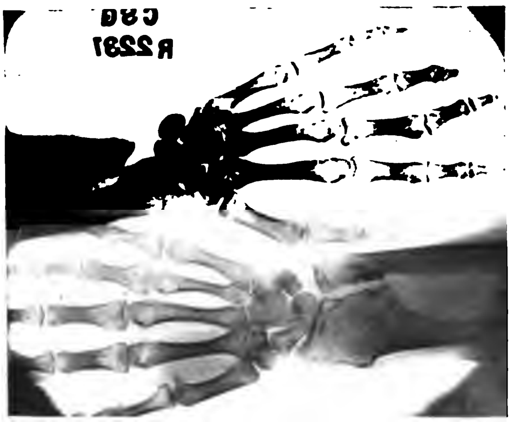

FIG. 9.

SUMMARY

Certain manifestations seem to be fairly constant in the four cases of which prints

of the roentgenograms are here shown, and of the associated cases of which I have reasonably authentic accounts.

1. In all four cases studied there is a marked common postural characteristic. The elbows are carried out from the body, the hands turned toward the ulnar aspect of the forearm and the knees bent inward and slightly flexed, so that the patient is decidedly knock-kneed, especially in Cases I and II, who were advanced in years.

FIG. 10

FIG. 11.

This was so marked in Case I as greatly to interfere with his walking. The head is carried slightly forward.

2. The fingers in all four cases were inclined to be short for the width of the hand, but were capable of complete flexion and extension. They were not clubbed.

3. The long bones are most often affected, especially the femur, tibia, fibula, humerus, radius and ulna.

FIG. 12.

4. There appear to be three general types of exostosis; spurs, tubercles, and pediculated, cauliflower-like masses. When spurs occur, they are invariably pointed away from the nearest joint. I cannot say whether or not this is due to the natural strain of muscle and tendon attachment.

FIG. 13.

5. The regions usually affected are the

elbows, knees and wrists; all joints of great activity.

6. None of these growths are painful unless subjected to traumatism; nor are they especially liable to fracture, their size and location causing the only inconvenience suffered.

7. They begin to develop at an early age and are progressive so long as bone growth continues; none of them has receded so far as I know.

8. I was unable to detect any abnormality of the epiphysis of any bone in any of the four cases of which roentgenograms were made.

9. There is a marked hereditary or at least familial tendency.

10. Bilateral symmetry as to position is the rule; but usually one side is more affected than the other.

From a practical standpoint it should be borne in mind that endostoses occur as well as exostoses. In 1917, Ochsner and Rothstein reported a case of multiple exostosis in which an intraspinal, pediculated endostosis on the anterior aspect of the right lamina of the second cervical vertebra, pressing upon the cord, caused incoordination of upper and lower extremities; operation improved the condition. Also in the same year Clark and Atwood reported "a case of multiple enchondroma, one of which is growing from the sella turcica, causing pressure on the pituitary body," which evidently produced spastic quadriplegia. Undoubtedly, in many cases where exostoses have been so located as to cause pain in joint movement, a diagnosis of articular rheumatism has been made. It therefore seems that in any case where exostoses are detected and symptoms of nerve pressure, arthritis, etc., are present, careful, intensive roentgenography should be thoroughly carried out.

My study of this subject in the four cases shown, and a review of the literature, especially the article by Ehrenfried, which comprises a study of about 600 cases, lead me to agree with him that we have in this condition a definite pathological entity that is by no means rare, and which may give rise to certain very serious consequences; that the condition appears to be hereditary, and is most often present in the extremities. The exact etiology has not as yet been settled; therefore it is highly desirable that every case coming to the attention of roentgenologists, as well as of surgeons and clinicians, should be thoroughly studied and reported, with the hope that the causative factors may, if possible, be determined.

HYDATID DISEASE OF BONE

BY HERSCHELL HARRIS, M.B., CH.M.

SYDNEY, NEW SOUTH WALES, AUSTRALIA

THIS disease is always difficult to diagnose radiographically, as the appearances are so similar to an osteomyelitis. In the present case when seen eighteen months previously, and on careful comparison with the opposite tibia, a faint difference was noticed in so far as the affected tibia presented an area of very slight absorption.

The symptoms were not very marked at the time and the patient complained mainly of a slight pain below the knee. An inflammatory lesion was diagnosed. Various methods of treatment were adopted, but all without avail.

When next she presented herself some fifteen months later for another radiographic examination, the appearance as shown in the accompanying plate was present. The area of absorpton had greatly increased, and was quite well defined. Also a small loose piece of bone was seen lying alongside of the tibia. Meanwhile the symptoms had increased and the pain

FIG. 1.

was more severe, and some swelling was present.

A diagnosis was then made of tubercular osteomyelitis.

An operation was performed and hydatid of the bone was found, involving the medulla of the upper third of the tibia. The diseased tissue was curetted away, the cavity was packed, and a good recovery ensued. The case is worth recording, as hydatid disease of bone is not common. During my twenty years experience with the roentgen rays, it is the fifth case I have encountered. One involved the lumbar vertebræ, and was diagnosed as caries of the spine. Later on an operation revealed the condition. The other four cases involved the humerus and femur, and a spontaneous fracture occurred in each case. Union did not take place and it was a subsequent operation which disclosed the condition.

When hydatid occurs in bones, usually the medulla is involved and the growth is fairly rapid, and eventually the whole medulla becomes involved. Early operation offers the best prospect of success, and consequently an early diagnosis should be arrived at in these cases. I am afraid that this will not often be made, but still if we can diagnose osteomyelitis it will probably be the means of an operation being performed and the condition then being revealed.

PEDUNCULATED MALIGNANT GROWTHS OF THE STOMACH

BY DR. GEORGE W. HOLMES

BOSTON, MASS.

THE object of this paper is to call attention to a fluoroscopic sign which is fairly constant and of considerable value in the diagnosis of pedunculated tumors of the stomach, and to place on record two cases which seem to me to be of considerable interest.

Polypoid tumors of the stomach, either benign or malignant, are relatively rare. Alfred Tigler, in thirty-five hundred autopsies, found but fourteen benign tumors of the stomach. Versé, out of fifty-five cases of polyp of the digestive tract, found only four which were in the stomach. Ebstein, in 1864, in six hundred autopsies found fourteen cases of stomach polyps and collected reports of eight others from still earlier writers. Myer, in 1913, reported a case in which the diagnosis made prior to operation or necropsy, was based on peculiar sounds and palpation sensations and on studies made of a piece of the tumor found in the stomach washings. In the fluoroscopic and roentgenographic examinations made by Carman there were absence of filling of the anterior end of the stomach and almost total obliteration of the pylorica. The barium mixture passed through this portion of the stomach in such a way that it suggested the outline of a mass. There was no evidence of gastric stasis and no report of the appearance of the peristaltic wave. Basch reports three cases with a complete description of the roentgen ray findings,—all three showed large circular filling defects. He noted that there were hyperistalsis and hypermotility, but does not state whether there was a break in the peristaltic wave when it passed over the site of the tumor.

The cases which I wish to report were studied roentgenologically by me at the Massachusetts General Hospital and were operated upon by Dr. C. A. Porter.

The first (H. M.), a man of forty-eight years, was seen in 1913. A brief outline of the history follows:

Eructations of gas with occasional vomiting for twenty-eight years; no pain; no signs of blood. Three months previous to admission he developed a sensation of oppression in the epigastrium, with increased eructations and vomiting, vomitus containing food taken two days previously. The oppression was relieved by dieting. In the physical examination it was noted that there was loss of weight but no anemia. The chest showed dullness at the right apex which was confirmed by roentgen ray examination and thought to be tuberculosis. The Wassermann test was negative. Examination of the stomach contents: 65 c.c. free HCl 0. Guaiac positive. No sediment. Test meal: 220 c.c. Free HCl 0.29 per cent. Total acidity 0.12 per cent.

A medical consultant at this time stated that there was a soft gland palpable above the left clavicle, and that in the examination of the abdomen a mass could be felt in the region of the pylorus.

Roentgen ray examination of the gastrointestinal tract showed a large, low stomach with sluggish peristaltic waves which passed entirely over both curvatures. The pyloric sphincter and duodenal cap were not made out. The emptying time was not recorded.

The conclusions were that there was a pathological process at the pylorus and that this process was probably ulcer.

At operation, a rather large tumor was seen and felt at the pylorus, it seemed to be movable. The stomach was opened and a soft lobulated tumor, the size of a small lemon, was seen lying in the pylorus and duodenum. Another similar but smaller tumor was seen on the greater curvature of

the stomach. There was no evidence of ulceration and no glands; the mass was movable and resection seemed possible, but in the opinion of the operator, gastroenterostomy followed by a second operation offered the best chance to the patient.

The opinion of the pathologist at the time of the operation was that the tumor was a sarcoma of the stomach and duodenum.

Four weeks after the first operation a second was performed. The tumor had not changed in size and was lying in the pylorus on the duodenal side of the pyloric vein, prolonged backward to the left and to the greater curvature of the stomach. The anterior wall of the duodenum and pylorus moved over it as if it were a polyp. There was no infiltration of the walls demonstrated. The anterior portion of the stomach and the duodenum were resected.

The patient was in rather poor condition following the operation but made an uneventful recovery and was discharged from the hospital relieved.

The pathological note on examination of the specimen is as follows:

> Portion of the stomach and duodenum: Section shows the pyloric opening filled with a plum-sized tumor mass adherent to the greater curvature, surface ulcerated, reddened, section smooth and attached to the mucosa by a broad base. A few soft lymph nodes. Microscopical examination showed a very cellular growth with fibrous tissue and occasional very large cells. It is covered by a little thin mucous membrane. At the base there is an infiltration of the growth between the bundles of muscular tissue. Diagnosis: Fibrosarcoma.

After examination of the lungs by a medical consultant at the time of discharge, a diagnosis was made of fibroid phthisis of the upper lobe of the right lung with infiltration of the left apex.

In a letter received from the patient on April 20, 1919, six years after the operation, he states that he has been entirely free from symptoms; is well, strong, and going about his work in the usual manner.

The second case (B. J. P.), is that of a man aged forty-seven. The only note of interest in the past and family history is that he had glands in the neck when six years old which a doctor called "scrofula." For a period of more than a year, the patient has had attacks of pain around the navel, radiating to a corresponding point in the back, at times followed by vomiting. He vomited blood several times. There was a gradual loss of weight (in all, 32 pounds), so that he was unable to attend to his work. The pain, which was sharp and severe, was apt to occur in the morning before breakfast; he was not disturbed at night; and though almost immediately relieved by taking food, it persisted for an hour or more when food was not taken. The pain was also relieved by soda and by vomiting. Eleven months ago, in an attack of vomiting he noticed what he thought to be a clot of blood, about the size of a walnut, in the vomitus. At that time he was admitted to the Massachusetts General Hospital and remained ten days, during which time there was no vomiting attack. While in the hospital, however, he had some acute infection with râles in the lungs, and rise of temperature to 104.6°. This lasted about four days and cleared up.

Roentgen ray examination of the stomach made at this time showed a low, large stomach, normal in outline and peristalsis; the peristaltic wave passed completely over both curvatures. There was a small residue at the end of six hours, and a large filling defect of the media resembling a gas bubble which was movable, but which was present in all positions on different days. The examination of the colon was not remarkable. The conclusions from the roentgen ray examination were that the findings were probably due to a polypoid tumor in the mid-portion of the stomach.

About a week previous to the present entry, the patient vomited half a cupful of chocolate colored fluid. He was very weak, and incapable of any exertion.

The physical examination showed evidence of emaciation and pallor; the radial arteries were palpable and tortuous; an indistinct mass was felt in the abdomen, otherwise nothing of importance noted. The urine was negative; hemoglobin 40 per cent. The Wassermann was negative. An examination of the stool showed the

FIG. 1. THIS PLATE WAS MADE WHEN THE STOMACH WAS NEARLY EMPTIED AND AFTER A RATHER PROLONGED FLUOROSCOPIC EXAMINATION. FOR THIS REASON IT IS RATHER UNSATISFACTORY. IN THE MIDDLE OF THE STOMACH SHADOW, HOWEVER, CAN BE MADE OUT THE MOTTLING DUE TO THE PRESENCE OF THE POLYPI.

presence of blood. A test meal resulted in 70 c.c. of clear fluid, no free HCl; total acidity 10 c.c. n/10 NaOH = 0.04. Microscopic examination showed starch granules, no sarcinæ, guaiac test being faintly positive.

Roentgen ray examination at this time showed a marked increase in the size of the mottled area (noted at the previous examination) which now filled the greater part of the mid-portion of the stomach and presented an appearance more like that of extensive carcinoma. The stomach was dilated and atonic, and peristalsis was absent during the entire examination. The stomach was empty at the end of six hours. Without the previous roentgen ray findings, it would have been impossible to make a definite diagnosis at this time.

At operation, on opening the abdomen the mesentery was found to be edematous, there was free fluid in the pelvis; the stomach was dilated. There was no evidence of cancer in the wall, but it was very clear that it contained two large polypoid masses the bases of which could not be

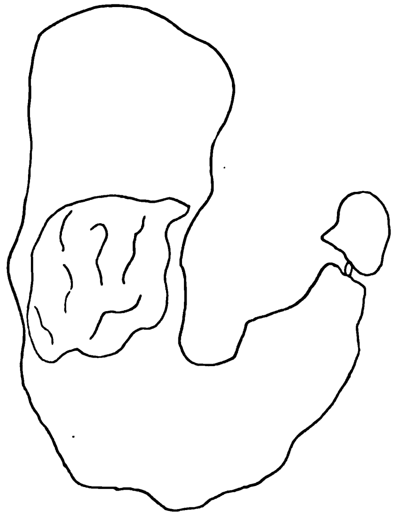

FIG. 2. THIS TRACING GIVES A FAIRLY GOOD IDEA OF THE POSITION AND SIZE OF THE TUMOR IN RELATION TO THE STOMACH. IT ALSO SHOWS THE ABSENCE OF A BREAK IN THE OUTLINE OR PERISTALSIS.

made out. The stomach was opened, and definite groups of polypi, the largest the size of a lemon, were seen. Clamps were applied and the polyps removed; the veins sutured, and the stomach closed.

The pathological report reads:

> Two soft round or oval tumors, one the size of a hen's egg, the other a little smaller. They have a narrow surface and on section show a moist, reddish gray crater, with a white central core. Microscopical examination shows the

NOTE.—Figs. 2–3–4 represent tracings made at the fluoroscopic observations.

mucosa infiltrated with a richly cellular tumor which for the most part shows no definite structure at the periphery. There are irregular spaces which contain serum and blood cells

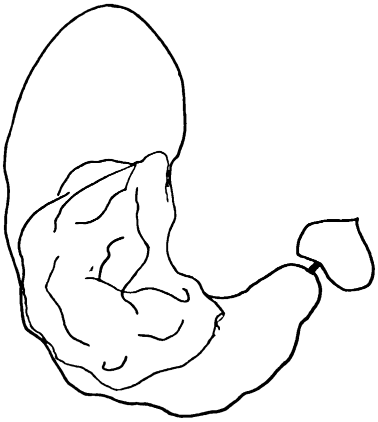

FIG. 3. THIS TRACING WAS MADE ELEVEN MONTHS AFTER FIG. 2, AND SHOWS THE INCREASE IN SIZE OF THE TUMOR DURING THIS PERIOD.

and are lined by cells similar to those of the tumor. In these spaces the cells spring from the wall in an elevated rounded form and have large rounded or oval nuclei. Diagnosis: Lymphangio-endothelioma.

The patient made an uneventful recovery from operation. A month later, at the time of his discharge, the roentgen ray examination showed no evidence of recurrence of the mass in the stomach. The mid-portion was somewhat contracted and the rugæ were visible. There was no stasis and no irregularity in peristalsis.

SUMMARY

Both of these cases had definite pedunculated tumors. In general, tumors of this kind are not malignant. In both cases the peristaltic waves passed over the involved area of the stomach without evidence of break, such as is seen in lesions which involve the gastric wall.

When the gross pathology of these growths is considered, there is no reason to expect that the wave would be obstructed. The appearance of the shadow of the bismuth-filled stomach in a case with polyp is most suggestive of the pictures seen when there are large masses of food present, or of advanced carcinoma.

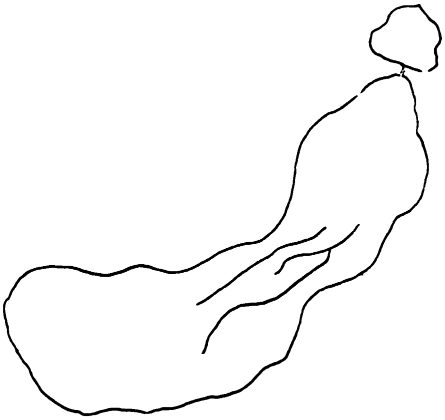

FIG. 4. ILLUSTRATES THE SIZE AND SHAPE OF THE STOMACH AFTER THE TUMOR HAD BEEN REMOVED.

There are two cases, one reported by Myer and another referred to by him, in which the diagnosis was made previous to operation or autopsy. In both cases the diagnosis was made after microscopical studies of pieces of the tumor in the

FIG. 5. FROM BASCH'S ARTICLE ON "PRIMARY BENIGN GROWTHS OF THE STOMACH." IT ILLUSTRATES VERY PRETTILY THE PERISTALTIC WAVES PASSING OVER THE AFFECTED AREA.

stomach washings. So far as I know, Case 2 of this report is the first case in which a diagnosis of gastric polyp was made on the roentgen ray findings.

It is of interest to note that in both of these cases the Wassermann was negative, as the question of a syphilitic origin of benign tumors of the stomach has been raised.

The literature on fibrosarcoma of the stomach is very scanty. The only author I have been able to find who discussed it at all completely was Fenwick. More recent writers and the pathologists whom I consulted consider it extremely rare and very little is known about its course.

The fact that the patient in the case first mentioned in this report is entirely well at the present time might lead one to doubt the accuracy of the diagnosis. The pathological report which is quoted was made by Dr. Whitney of the Harvard Medical School, and a recent discussion with the pathologist of the department confirms his observations.

The differential diagnosis in these cases from the point of view of the roentgenologist is from foreign bodies (including food) in the stomach and large carcinomata. Food can be ruled out by repeated examinations. Gastric cancer, which displaces the barium shadow in a way simulating polypi, as a rule involves the wall of the stomach sufficiently to prevent the free passage of the peristaltic wave.

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CHEST ROENTGENOLOGY IN THE SELECTIVE SERVICE EXAMINATIONS

BY W. WARNER WATKINS, M.D.

PHOENIX, ARIZ.

EARLY in the examinations under the Selective Service Act, Cole insisted on the value and practicability of roentgenology in detecting tuberculosis in the drafted men, making a practical demonstration of his claims. Partly on account of the unwillingness of the examining boards to admit the value of this method of detecting tuberculosis, but chiefly because most of the trained roentgenologists of the country promptly entered army service, it was found impossible to make general use of roentgenology in routine draft examinations before the men were taken to the mobilization camps. In the examination of the soldiers at these camps, the value of fluoroscopic and roentgenographic examinations in suspected chest diseases has been abundantly demonstrated. It may be of interest to report a series of cases examined in ordinary draft work.

Medical Advisory Board No. 2 of Phoenix, Ariz., asked its roentgenologist (the writer) to make roentgen ray examinations of all heart and lung cases, which was done. The vast majority of the examinations were fluoroscopic, plates being made in less than one-third of the lung cases. It was found perfectly feasible, under our arrangements, for the roentgenologist, with one assistant, to examine the registrants with the screen and make plates, when necessary, as rapidly as four chest examiners could make the physical examinations. The greater facility of the fluoroscopic examination was immediately apparent, and it became simply a question

of accuracy, if the methods were to be compared.

Our routine was to fluoroscope the heart, making a diagram outline of it, with measurements marked and notation of any abnormal pulsations. The lung shadows were recorded and kept as a separate record until the physical examinations had been made; the roentgenologist then compared the two and if they disagreed in essentials, a roentgenogram was made. The physical findings and roentgen ray findings would then be presented to the Board, which would decide upon the disposition of the registrant.

The results of the physical and roentgen ray findings on 1140 men examined by the Board for chest disease is given in the accompanying table.

RESULTS OF PHYSICAL AND X-RAY EXAMINATIONS OF 1140 DRAFT MEN

Qualified by the Board as to Chest Condition	462
Normal by physical examination and normal by x-ray examination	316
Normal by physical examination and slightly abnormal by x-ray examination	90
Slightly agnormal by both examinations	39
Slightly abnormal by physical examination, and normal by x-ray examination	17
Disqualified by the Board as to Chest Condition	678
Disqualified by either examination	264
Normal by physical examination and disqualified by x-ray examination	148
Abnormal by physical examination, (see note) and disqualified by x-ray examination	225
Abnormal by both examinations and disqualified by correlating the two	41

(NOTE: Of the 225 found abnormal by physical examination, 117 had such trivial abnormalities that they should have been classed as normal, according to the instructions of Form 75.)

Discussion:—There were then 462 men, or 40 per cent of the group examined, whose lungs were found to be practically free from disease. This is important because, in spite of the fact that the majority of these were referred to us on account of suspicious chests, the roentgenologist passed them as practically normal, refuting the frequent charge that he will find abnormal shadows in all chests. This series demonstrates that he is no more likely to make wrong interpretations of what he sees than the clinician is of what he hears with the stethoscope.

On the other hand, there were 265 cases, or *twenty-four per cent of the number examined*, who would have been qualified on their physical findings and sent to the mobilization camps had they not been examined by the roentgenologist. About five years ago, the writer gave as his estimate, that one case in five of pulmonary tuberculosis would have lesions of such a character or so located that the average chest examiner would detect no variation from the normal in physical signs. This estimate is closely approximated by this twenty-four per cent whose lesions escaped detection by the auditory and tactile methods of physical examination. This twenty-four per cent does not include the men whose physical findings suggested tuberculosis and who were sent to the roentgenologist marked "suspicious." There were 108 of these who, as soon as suspicious signs were found, were sent forthwith to the roentgenologist as a more expeditious method of disposing of the registrant.

A relatively small group of eighty cases are important in that their physical findings and roentgen ray findings were both abnormal, but neither sufficiently so to warrant definite diagnosis of tuberculosis; and conferences between clinicians and roentgenologist, frequently with re-examinations of the registrant, were necessary to arrive at conclusions. Thirty-nine of this group were qualified and forty-one disqualified. This group illustrates the fact, often overlooked, that the usual procedure in utilizing the roentgen ray in lung examination is wrong. The roentgen ray should be used as a part of the physical examination, with the idea of visualizing patholog-

ical changes through the eye, just as the stethoscope is used to visualize them through the ear, or the fingers through the tactile sense. Instead of regarding the clinical and the roentgen as different, and often antagonistic, methods of examination, we should look upon the roentgen ray as the addition, simply, of another leg to the old tripod upon which physical examination has heretofore rested.

It is evident, in this series of cases, that, so far as the detection of the bare presence of tuberculosis of the lungs is concerned, the roentgen ray would have been sufficient in itself, because every case diagnosed by physical examination was readily detected by the roentgenologist. On the other hand physical examination alone would not have been sufficient, since it failed to detect undeniable tuberculosis in twenty-four per cent of the men examined. However, in the detection of activity in any given area in the lung, the roentgen ray must yield to physical examination. Col. Bushnell's criteria for roentgen ray shadows which must be considered disqualifying, as laid down in Forms 64 and 75, were followed as closely as adherence to recognized roentgenographic pathology would permit. No case was rejected on roentgen ray shadows unless they were at least as marked as those described by him, and many were qualified when the basal shadows mentioned in Forms 64 and 75 were present, but when in the opinion of the roentgenologist they did not indicate tuberculosis. No registrant was disqualified on shadows limited to the neighborhood of the hilum.

CONCLUSIONS

In the examination of 1140 drafted men for chest disease, in no instance did the physical examination detect tuberculosis which was not also readily shown by roentgen ray.

In twenty-four per cent of 1140 men examined, the physical examination failed to detect a disqualifying chest disease which was demonstrated by the roentgen ray.

In detecting the bare presence of tuberculosis or other disqualifying chest disease, the roentgen ray would be sufficient in itself; but to determine the presence of activity, physical examination is necessary.

In any thorough physical examination of the heart or lungs, the roentgen ray should be employed, unless the examiner is willing to accept the risk of twenty per cent error.

PROSTATIC CALCULI FROM THE ROENTGEN RAY DIAGNOSTIC STANDPOINT *

BY MAXIMILIAN J. HUBENY

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CHICAGO, ILL.

PROSTATIC calculi occur much more frequently than is suspected. In 1914, Gläsel[1] in the German literature collected fifty-four cases. Recently Kretschmer[2] has extended this to 173 up to the end of 1917. The earliest citation on this subject is one by Marcellus Donatus[3] as far back as 1586.

Prostatic calculi are classed as true or false. They are also known as primary, autochthonous or endogenous; and secondary, metastatic or exogenous. The true or primary calculi originate in the parenchyma of the gland from deposition of phosphates, etc., around some degenerated tissue nucleus; the secondary stone reaches the prostate from the kidney, bladder, etc. Many of these secondary stones are not really prostatic but belong to the prostatic urethra. True prostatic calculi in composition consist of more than 80 per cent phosphate of lime, and may thus to a large extent be differentiated from secondary calculi.

Although the diagnosis of prostatic calculi can in every case be definitely established by means of the roentgen ray, it is surprising how limited has been the application of this diagnostic method. Forssell[4] in 1909, reporting on the roentgenologic diagnosis of prostatic calculi, was able to find in literature only four cases in which a roentgen examination was made. Since then cases have been reported by Cholzoff,[5] Cochez, Brickner,[15] Moucharinsky,[6] Naumann,[7] Ravasini,[8] Thompson,[9] Voelcker,[10] Pasteau,[11] and Daubert and Beaujeu.[12]

Forssell[4] was the first to make a thorough study of the value of the roentgen ray in prostatic calculus diagnosis. He made roentgenograms of eleven cadavers and then dissected out the gland. He found two cases with prostatic stones. He also examined 100 living subjects. In thirteen of the 100 subjects examined, he found prostatic calculi. The calculi were of two types. In the first type the shadows of the stones appeared as small, round, discrete dots, varying in size from that of a pinhead to a hemp-seed, and arranged symmetrically on each side of the mid-line just above the symphysis. This type of calculus appeared to be a normal result of senility. Between the ages of twenty and fifty years it only occurred in 5 per cent of the cases; from fifty to ninety-three years it occurred in 20 per cent. The second type of calculus occurred as good-sized patches made up of conglomerations of the small ones. They show higher up in the pelvis from 1.5 to 3 cms. above symphysis. This type does not seem so definitely a senile condition, as it apparently occurs in middle life from pathological changes. Forssell thinks that the arrangement, form and density of prostatic calculi are very characteristic, and that differentiation from other pelvic concretions is possible; also that they can be distinguished by careful roentgen ray examination. Kretschmer[2] thinks that the symmetrical arrangement referred to may change as time elapses; and that the grouping of the shadows is by no means constant. Kretschmer gives roentgenograms of eight cases examined by him. Forssell also gives two plates. From these plates it appears evident that there is much diversity in the arrangement of the stone shadows.

The necessity for careful and repeated

* Read before the Western Section of the American Roentgen Ray Society, March 22, 1919.

examinations and for intensification of plates is evidenced by some cases in which earlier roentgen ray examinations failed. Thus Daubert and Beaujeu[12] reported a case in which the symptoms suggested vesical calculi. No stones could be found on exploration, and a roentgenologic examination was negative. A second radiologic examination was made in a different position, and with bismuth solution in the bladder showed shadows exterior to the bladder. Operation confirmed the roentgenologic diagnosis, stones being found in the prostate. Pasteau[11] similarly found that in a patient who had been considered a case of vesical calculus, the calculi were in the prostate, and that on dilating the canal the stones were expressed without need for further operation.

That routine roentgen ray examination of the prostate, in cases where it is indicated, is far from being current practice is indicated in recent reports on prostatic calculi. Townsend[13] reporting a case says: "From conversation with several *x*-ray men I have learned that occasionally prostatic calculi are discovered; but as far as they know it is not a routine practice among genito-urinary men." Peterkin[14] having made several examinations in a manifest bladder calculous case examined by the roentgen ray states: "The *x*-ray is essential as a means of obtaining direct and corroborative evidence of pathological conditions of the bladder. In this case the *x*-ray gives direct evidence, the cystoscope negative evidence." In this case of Peterkin, infection and urinary deposits completely replaced a normal prostate and substituted one of stony formation. The condition was revealed by the plates.

Kretschmer says that the routine employment of the roentgen ray for the demonstration of stone in all obscure cases should be strongly urged, especially in cases of so-called chronic prostatitis which do not respond to the usual forms of treatment.

In the plate the shadows of prostatic calculi usually show behind the symphysis pubis.

Kretschmer also states that the routine use of the roentgen ray after operation for removal of calculi should always be carried out so that the operator may be assured that all stones have been removed. Examination of the literature shows that such a precaution is usually neglected.

Brickner[15] in 1913 in reporting on the diagnosis of prostatic calculi, stated two propositions:

(1) If a roentgenogram of the unemptied bladder, exposed with the patient in the level supine or reversed Trendelenburg position, shows a shadow or group of shadows in the region of the neck of the bladder; and a second roentgenogram, exposed with the patient in the Trendelenburg position, and the roentgen rays passing in the same relative direction, shows the shadows in the same place as before; the stone or stones are fixed in the prostate, or the prostatic urethra, or in a diverticulum behind the prostate.

(2) The absence for a long period of time of all signs of local infection in a case of purulent prostatitis, is strongly suggestive of a calculus etiology.

Brickner illustrates two cases of prostatic calculus with two roentgenograms, both in patients over sixty years of age.

The points established in the literature appear to be:

1. That prostatic calculi occur much more frequently than is thought.

2. The condition is often confounded with chronic prostatitis, etc.

3. That stones in the prostate can certainly be diagnosed by the roentgen ray.

4. That the demonstration of stones by the roentgen ray will often obviate the operative opening of the abdomen and bladder, as in many cases the stones can be expressed through the urethra.

Case Report.—Referred by Dr. Walter Venn. Male, aged fifty-seven, excellent physical condition. Had measles during childhood; pneumonia at fifteen years of

age; typhoid at thirty-five, and gonorrhœa at twenty years of age.

Present Complaint.—Frequency of urination began about two years ago. Recently he has had occasional attacks of inability to urinate with burning on urination, both before and after the act. A constant desire to urinate was not present. The frequency had gradually increased until at the present time it is six or seven times during the day and two or three times at night. He passes but a small quantity of urine at a time. About two months ago, following a fall, he was unable to urinate from two o'clock in the afternoon until late at night. A catheter was used at that time, but not since.

FIG. 1. MULTIPLE CALCULI. FIFTY-FOUR ARE DEMONSTRATED ON THE PLATE.

Examination showed the external genitals negative. Reflexes were good. Prostate was greatly enlarged, smooth, regular and even, with no nodules or tender areas. Seminal vesicles were not palpable.

Blood examination showed 7500 leucocytes and 58 per cent hemoglobin. Blood pressure was 128 systolic and 68 diastolic. Urine was bloody with a specific gravity of 1020. There were few epithelial cells, many red blood cells, a few leucocytes, and no bacteria. Culture of the urine was negative.

FIG. 2. SAME CASE AS SHOWN IN FIG. 1, WITH COMPLETE DISAPPEARANCE OF SHADOWS AFTER EVACUATION FOLLOWING PROSTATIC MASSAGE.

FIG. 3. MULTIPLE PROSTATIC CALCULI AND VESICAL CALCULUS PRESENT IN SAME PATIENT.

The roentgenogram showed the presence of many calculi (fifty-four could be counted on the plate) situated medially and suprapubically, corresponding to the usual location of prostatic stones. Chemical analysis by Dr. R. W. Webster showed the predominance of calcium phosphates. A roentgenogram of a few of the calculi which were expressed after prostatic massage showed that a fusion of several smaller calculi had taken place.

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A PROTECTED CHAIR FOR ROENTGENOSCOPY *

BY HAROLD ZIMMERMAN, M.D.

Captain M. C., U. S. A.

SAN FRANCISCO, CALIF.

IN spite of our present day knowledge of the dangers arising from roentgen ray exposure, and the general protection of apparatus by the manufacturer, we still find many fluoroscopic tube boxes inadequately protected and leaking badly about the adjustable diaphragm. To the roentgenologist who spends long hours at screen work this question of protection from exposure may lead to a degree of justifiable apprehension. During the past year the amount of fluoroscopic work at the Letterman General Hospital suddenly grew to considerable volume, and in order to safeguard ourselves against excessive radiation we built a protected chair for roentgenoscopy which we think, by virtue of its simplicity and efficiency, might be considered worth while by other roentgenologists.

The general plan of this chair is shown in the accompanying illustration. In brief it is a modification of the ordinary straight back chair. The operator however does not *sit* in the chair in the usual position but *sits astride* the chair, the *back* of the chair becoming a *shield* intervening between the chest of the roentgenologist and the fluorescent screen.

The chair is preferably built of oak or some heavy wood to give it stability. It should be about the size of an ordinary chair, legs 19 inches high, seat 16½ inches square. The upright protecting shield of ¾-inch pine extends about 24 inches above the seat and also a short distance below the seat. This will permit it to extend well up under the chin, but is not high enough to interfere with full flexion of the neck as required in looking downward in gastro-intestinal examinations. The width of the shield is the same as the seat of the chair, 16½ inches, and on each side at the seat it is cut in about 2 inches for the knees. The shield should not be wide enough to interfere with the full freedom of the arms necessary in gastro-intestinal manipulations. The protecting plate, instead of slanting from the seat as in the ordinary chair, is made to slant toward the seat about 7 degrees, or to overhang the

* Authority to publish granted by the Board of Publication, Surgeon General's Office.

seat about 3 inches. With the shield in this position the chair is far more comfortable. It allowes a freer range of vision downward, and neutralizes the top-heaviness that arises from its lead protection. The upright chest board is covered on the outside with 1/16-inch sheet lead.

find how little the shield interfered with the approximation of the eye to the image.

For roentgenologists of smaller stature, the dimensions given above should be cut down proportionately.

This apparatus protects not only the genitals and the abdominal viscera but

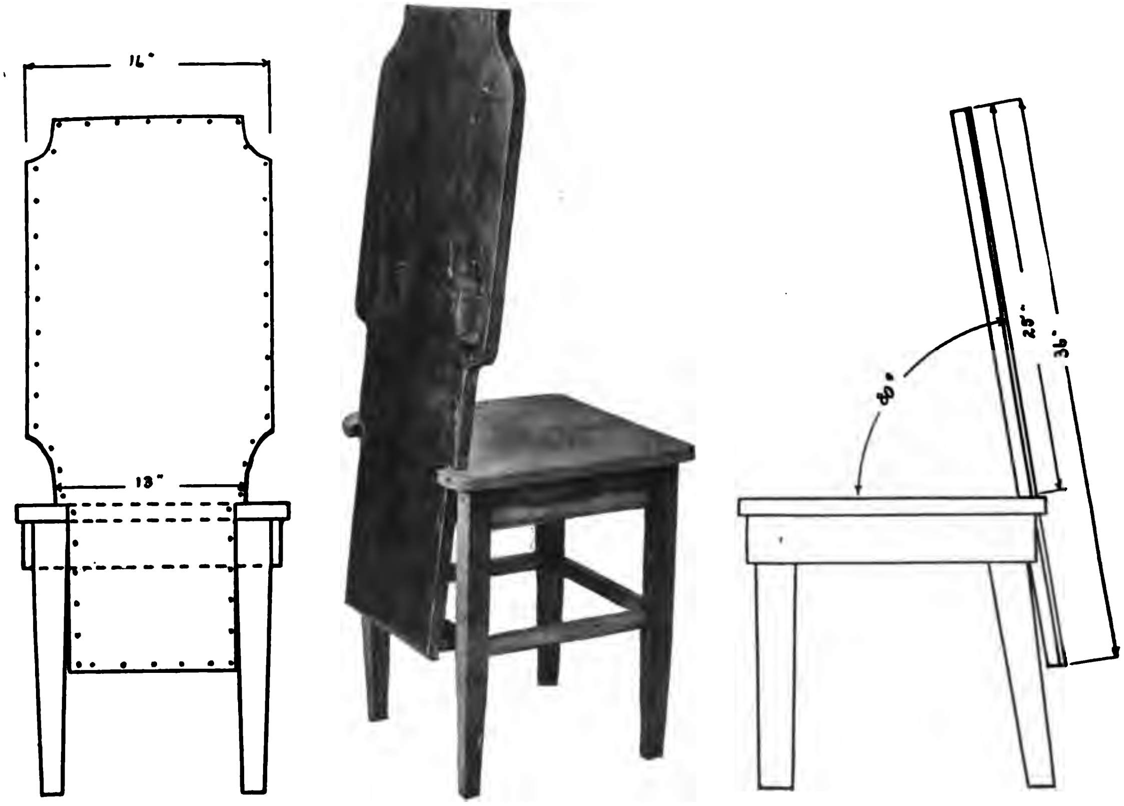

FIG. 1. THREE VIEWS OF PROTECTED CHAIR.

If this apparatus is supplemented by a 6-inch stool on which to stand short patients, it can be conveniently employed in practically all cases of upright fluoroscopy.

While the idea of this intervening plate between the body and the screen may seem awkward, we were agreeably surprised to find this chair quite comfortable, and to

also the chest. We find it much more satisfactory than the false protection of a heavy leaded rubber apron hung from the shoulders. Wings for the protection of the thighs and legs might easily be appended, but we have preferred to use the chair in its original form, which seems to give the maximum amount of protection with the minimum of apparatus and inconvenience.

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FOREWORD

The vision of the early workers in roentgenology concerning its various fields of usefulness seems to have been well conceived, if the present activities indicate its future development. In the early days therapy in various diseases was attempted and diagnostic work of all sorts was undertaken, some of which was successful; other attempts, owing to lack of knowledge of the action of the rays and to mechanical difficulties, were failures and were given up.

Later, with broader and truer ideas gained by experience, some of the failures were reconsidered, successfully; the improved mechanical and electrical facilities of various types assisted materially in reaching a solution. These advances have been painfully slow at times, while again they have been almost meteoric in their swiftness. The problems are not all solved. Much remains which requires the attention of the most studious, most energetic and most enthusiastic.

A national society was organized years ago as a source of inspiration by the interchange of ideas, and with the extension of the work came the desire for a closer union between workers in certain localities, resulting in the formation of societies in large cities, as the Philadelphia Roentgen Society; or where the population was less centered, in the formation of sectional societies, as the Pacific Coast Roentgen Society. The great war has brought many new men into the field, most of whom received the excellent course of training offered by the army.

Most of these men will doubtless continue in the practice of roentgenology. They will probably constitute a considerable number of the future roentgenologists of this country. They are the ones who will supply the new ideas, and their vision should be very comprehensive, due to their having been closely associated with the best in foreign and American medicine.

Therefore a most hearty welcome is extended to every one who enters this field, whether it be as a pure physicist, a biological chemist, a pathologist, therapist or diagnostician. There is plenty of room for all.

PROCEEDINGS

Omaha Roentgen Ray Society

The Annual Meeting of the Omaha Roentgen Ray Society was held in Omaha, April 5, 1919. *X*-ray Clinics were held at St. Joseph's Hospital by Dr. A. F. Tyler and at the University of Nebraska Hospital by Dr. C. H. Ballard. The regular sessions were held in the ballroom of the Hotel Fontenelle.

The morning session was called to order by the President, Dr. A. P. Overgaard. Dr. A. F. Tyler of Omaha read a paper on Deep Therapy, and Dr. R. L. Smith of Lincoln gave a cinematographic demonstration of the massive dose method. Both Dr. Tyler and Dr. Smith advocated using the maximum amount of dosage with the minimum amount of filter which could be used with safety to the patient, disregarding, in extreme cases, the cosmetic effect in favor of the cure.

Dr. B. H. Orndoff of Chicago led the discussion and said that he had never used the extreme dosage advocated by Dr. Tyler and Dr. Smith. He suggested that the roentgenologists and the surgeons cooperate in a new manner—by operating inoperable cancers, removing whatever cancer tissue was possible and leaving the area exposed. This area should be covered with the adhesive plaster recently advocated for growing skin without grafting, furthered by massive doses of *x*-rays, thus giving the rays a much better opportunity to destroy the cancer cells. By this method of cooperation and working he believes the percentage of recoveries in the inoperable cases will be greatly increased.

Dr. W. P. Wherry of Omaha read a paper on the Value of Roentgenograms of the Accessory Nasal Sinuses. Dr. Wherry thought that a mere report that the sinuses were clouded was of little value, but stated that by improved technique the roentgenogram could be made of much greater value.

In discussing this paper Dr. H. B. Lemere endorsed the suggestions of Dr. Wherry and urged greater cooperation in this work, saying the rhinologist needed the assistance of the roentgenologist in interpretation of the plates.

The first paper on the afternoon program was by Dr. Boyd Gardiner of the Mayo Clinic, who stated that they used an ordinary dentist chair in making roentgenograms of the teeth, and outlined the method of placing the films to get the best possible results. He illustrated with blackboard sketches just how the film should be placed. He stated that 97 per cent of the people going through the dental department needed extractions. This paper was discussed by Dr. B. H. Harms of Omaha.

Dr. A. L. Smith of Lincoln, Neb., talked on the subject of Dental Infection in Children. He made a very earnest plea that this source of infection be carefully watched, urging the cooperation of the dentist with the pediatrist. He pointed out many cases in which dental infection had played a large rôle in the health of the child and in its future welfare.

Dr. J. B. Fickes in discussing the paper urged that the physician follow up his recommendation that the child visit a dentist and work in harmony with the dentist. Both Dr. Smith and Dr. Fickes believe that all pathological conditions should be removed even though this necessitates the early removal of the first teeth, believing that the detriment to the second teeth and to the jaw formation is of much less importance than the undermining of the child's general health by the constant infection.

Dr. W. L. Shearer of Omaha read a paper on "Dental Roentgenology from the Standpoint of the Oral Surgeon" discussing the method by which infection from the teeth is spread throughout the body by the lymphatic system.

Dr. O. H. McCandless of Kansas City talked on Roentgenology of the Gastro-Intestinal Tract. He outlined very fully his methods, and illustrated the talk with lantern slides.

Dr. W. W. Wasson of Denver gave an illustrated talk on Roentgenology of the Chest, going fully into the findings as shown by the roentgenogram.

Value of the *x*-ray from the Internist's standpoint was the subject of Dr. A. D. Dunn of Omaha. Dr. Dunn advocated the *routine* use of the *x*-ray in diagnostic work, but insisted that it was but a single method and that *x*-ray diagnosis is a misnomer. He said that it was a morphological method and that the future medicine lay in physiological and biochemical methods. He urged that the work should be done only by specially trained and experienced roentgenologists who should refuse findings with possible interpretations and not make diagnoses.

Dr. B. B. Davis of Omaha discussed the Value of *X*-ray from the Surgeon's Standpoint. He spoke of the surgeon's dependence on *x*-rays as an aid in diagnosis, but he also urged that emphasis be laid on the word "AID" because the surgeon who overlooks his ordinary clinical methods and trusts the *x*-rays alone is headed for destruction. When used in connection with every other diagnostic aid Dr. Davis said he would take his hat off to roentgenology as one of the greatest helps known.

Dr. Roeder led the discussion and corroborated the statements of Drs. Dunn and Davis as to the value of roentgenology as an aid and stated that he believed the ratio of its importance was about the same as the ratio of roentgenologists on the program, which had been prepared by them, to the rest of the profession present, i.e., one to ten.

A banquet was served at 6:30 at the Fontenelle and the evening session was given over to returned war heroes.

Capt. N. C. Prince spoke on the subject of The Mobile *X*-ray Unit on the Western Front; Captain C. N. O. Lear of Des Moines, Iowa, told of his Experience in the First Line Trench Work, and Col. A. E. Merritt of Council Bluffs gave a cinema demonstration of the U. S. roentgen field apparatus, and a comparison with the apparatus of the enemy.

It was gratifying to hear that Germany was using roentgen apparatus of American make, but so antiquated as to be unrecognizable by the American doctors, also to hear Dr. Prince's assertion that the American equipment was exceptionally satisfactory.

A. P. Overgaard,
President

Western Section of the American Roentgen Ray Society.

An unusually well attended and enthusiastic meeting of the Western Section of the American Roentgen Ray Society was held at the Hotel Statler, Detroit, Michigan, March 22, 1919.

The meeting was planned by the Detroit members of the Society with Dr. P. M. Hickey as Chairman. The day was divided into a morning session for the reading and discussion of papers, two hours at noon for a luncheon and inspection of the new roentgen department at Harper Hospital, an afternoon session for further papers and discussion, and a lantern slide demonstration in the evening following the customary banquet. Many of the men recently returned from France were present, as were also those who were in the military service in this country, so that the social aspects of the meeting were much appreciated.

Dr. A. W. Crane was elected Chairman and called the first session at 10 A.M. The first paper presented was by Dr. M. J. Hubeny of Chicago on Prostatic Calculi. Dr. Hubeny illustrated his paper by a number of lantern slides and during the discussion of the paper and slides, it was discovered that there was wide variation in opinion as to the anatomical relations of the prostate. Several slides shown were clearly cases of calculi in the deep urethra and not prostatic concretions as was supposed.

Dr. Emil Beck of Chicago presented

some original work on the combined treatment by surgery and deep therapy of inoperable deep seated carcinoma. Two patients from Chicago were shown and the results obtained by Dr. Beck were really spectacular. Dr. Eisen, who cooperates with Dr. Beck, discussed at length his method of application of the ray. The general discussion which followed Dr. Beck's and Dr. Eisen's remarks demonstrated forcibly the necessity for the standardization of the technique of deep roentgen therapy.

The paper of Dr. M. W. Clift of Flint on the fluoroscopic examination in injuries of the head was well received, since Dr. Clift had based his paper on his experiences in several laboratories in France. The routine fluoroscopic examination of the skull was urged in all head injuries, the ability of the operator to rotate the patient's head in all directions during the study giving a distinct advantage to the procedure.

It was indeed fortunate that both Dr. Crane and Dr. LeWald were on the program. Dr. Crane presented some original work on the measurement of the heart shadow and also presented in a clear manner the results of Bardeen's work on the estimation of the size of the heart. Objections to the Bardeen method were raised by roentgenologists of excellent internal medicine training, it being claimed that the new method was far from being as accurate as the old orthodiagraphic method. Dr. Crane answered the objections and convinced his critics that the Bardeen method was superior to any yet presented. Dr. LeWald's paper on the Heart of Aviators was fully illustrated by lantern slides, and the technique and apparatus used by the cardiovascular examiners of candidates for the air service was fully explained.

Dr. Case of Battle Creek continued his custom of presenting something new in roentgen examination of the gastro-intestinal tract by showing a series of slides illustrating cases of postoperative ileus. Dr. Case advocated the routine examination of patients who showed any abdominal symptoms following the laparotomy, for in this way an early diagnosis would be obtained and correct treatment instituted in practically all cases of the condition.

Dr. Bowen of Columbus had no formal paper, but he demonstrated a number of time-saving features in the laboratory.

The paper by Dr. Grier of Pittsburgh on the treatment of Hodgkin's disease brought out again the marked difference of opinion regarding the proper technique of deep therapy. With special reference to Hodgkin's diseases it was the author's opinion that sufficient exposure should be given during the first series of treatments, because in his experience no case of recurrent Hodgkin's disease responded fully to the treatment. This was somewhat at variance with the experience of the other men present.

Dr. Darling's paper "The Commercial Invasion of the Practice of Medicine by *X*-ray Technicians and Commercial Laboratories Practicing Under Trade Names" aroused considerable discussion. There was a consensus of opinion that the danger of commercial laboratories was being overestimated and that the way to combat it was to render the best possible service and to be at least fair in the matter of the fees for the roentgen examination.

The banquet over which Dr. Crane so capably presided was followed by speeches laudatory of Dr. Hickey. Dr. Case spoke of Dr. Hickey as a soldier; Dr. Bowen of Philadelphia, as a roentgenologist; Dr. Rollin Stevens of Detroit, as a confrère; Dr. Chene of Detroit, as a teacher; and Dr. Evans as an associate.

The outstanding features of the lantern slide exhibit were an unusual series of cases of primary carcinoma of the lung presented by Dr. Bryan of San Francisco, and some original work on the gastro-intestinal in cases of hysteria by Dr. Van Zwalenberg.

Wm. A. Evans,
Secretary

TRANSLATIONS & ABSTRACTS

LEVIN, OSCAR L. The Ultraviolet Rays in the Treatment of Chilblain. (*Jour. A. M. A.*, Vol. 72, No. 12, p. 855, Mar. 22, 1919.)

The invisible ultraviolet and infra-red rays are to the right and left of the spectrum. The red and infra-red rays are heat producing and penetrating. The violet and ultraviolet rays produce a minimum of heat but possess marked chemical properties, are readily absorbed and are of value for therapeutic purposes. It has been shown that the therapeutic value of the sun is derived from the presence of the ultraviolet rays. Chilblain is essentially an erythema occurring in those with poor peripheral circulation and disturbed vasomotor tone. The good results obtained with the ultraviolet rays in this disease are probably due to the direct effect of the rays on the peripheral vessels and blood stream. It is therefore suggested that the rays be employed in the treatment of the condition, but not to the exclusion of other local and general measures. They are not only of value in removing the lesions, but if used sufficiently early in those who have had previous attacks they may prevent a recurrence.

BRODEN, A. C., Rochester, Minn. Basal-cell Epithelioma (From the Dept. of Surg. Path., Mayo Clinic). (*Jour. A. M. A.*, Vol. 72, No. 12, p. 856, Mar. 22, 1919.)

SUMMARY

1. Our present series of cases represents 13.4 per cent of 2,000 cases of general epithelioma.

2. Basal and squamous cells can be shown intimately connected in a neoplasm.

3. It seems to be a well-established fact that a basal-cell epithelioma can change into a squamous-cell epithelioma, or at least into an epithelioma in which the squamous cells predominate.

4. Basal-cell epithelioma occurs more often in males than in females, the proportion being about 3:2 in favor of the former.

5. The disease occurs in patients past middle life; their average age is 56.7 years.

6. It occurs more often in farmers than in any other class of people.

7. A family history of malignancy and a personal history of injury play a negligible part.

8. Previous mole, wart, pimple, eczema, scab, ulcer, etc., are associated in 37.1 per cent of the cases.

9. The duration of the lesion shows a marked variation; it extends from three months to forty-five years, and averages seven years and one month.

10. Ninety-six and twenty-eight hundredths per cent of all the lesions occur above the clavicle.

11. Thirty-six and nineteen hundredths per cent of all the patients had been either operated on or treated with acids, carbon dioxid, etc., before entering the Mayo Clinic.

12. In approximately 75 per cent of all the cases treated at the clinic there was either one incision with the knife alone or one excision with the knife immediately followed by cautery.

13. Of the 54.1 per cent of patients heard from, 75.86 per cent are living, of whom 75.45 per cent report a good result.

14. In the cases in which a good result was reported, 74.68 per cent of the patients had either one excision with the knife alone or one excision with the knife immediately followed by cautery.

15. The patients treated with acids, carbon dioxid, etc., before entering the clinic did not get so good a result as those who had no previous treatment.

16. The low grade of malignancy of the neoplasm is evidenced by its long duration, lack of metastasis in a single case in this series, response to proper surgical treatment, and by the fact that 75.45 per cent of the patients reported living have been free from the disease on an average of six years, one and six tenths months.

17. Of the patients reported dead, fewer than one-third died from this disease.

18. Excessive exposure to sunlight as a cause of the neoplasm has not been borne out by the facts in our series of cases. It was noted that the hand, which is exposed to sunlight at least as much as any part of the body above the clavicles, did not show lesions.

19. Practically all of the neoplasms in our series had their origin in the germinal layer of the epidermis of the skin. Only one was demonstrated to have originated from a hair follicle.

Ely, Leonard W., San Francisco. Legg's Disease: Arthritis Deformans Juvenilis: Osteochondritis Deformans Juvenilis: "Perthes's" Disease. (*Am. Jour. of Orth. Surg.*)

Under the title, "An Obscure Affection of the Hip Joint," Arthur T. Legg, of Boston, reported before the American Orthopedic Association, in 1909, a series of observations on five cases of a disease not previously identified, and published his paper in 1910. His report was brief, accurate and scientific. Very little definite has since been added to it.

In 1910, Perthes, of Tübingen, reported cases of the same disease, without recognizing their nature, publishing them as cases of Arthritis Deformans Juvenilis; that is, as cases of "arthritis deformans" in the young. In 1913 Perthes recognized that the disease bore little resemblance to what the Germans call arthritis deformans. Evidently he overlooked Legg's original paper. He excised from one patient a piece of the synovial membrane, and a piece of the head of the femur. The synovial membrane showed no sign of inflammation; therefore Perthes rightly concluded that the disease was not an arthritis. Neither the bone nor the cartilage showed evidence of inflammation, yet Perthes calls his "new" disease Osteochondritis Deformans Juvenilis.

Since 1013 many others in this country and in Germany have reported cases of the disease, and gradually the name Perthes's Disease has been adopted for it. A half-hearted attempt has been made in America to give Legg due credit, but I have never seen his name mentioned in the German periodicals. As the American Orthopedic Association is not a secret society, nor the *Boston Medical and Surgical Journal* an obscure periodical, one notes with amusement or irritation the recurrence of an oft-observed phenomenon.

Until the opportunity is afforded of examining some specimens in the laboratory, we shall lack definite knowledge of the disease, but the following facts, theories, and conclusions may be interesting.

Legg's disease is an error in development of the whole upper epiphysis of the femur—trochanter, neck and head. In this the acetabulum sometimes shares. It affects chiefly the head and the proximal lateral portion of the neck, and the cartilage between them. The great trochanter may or may not be involved.

It possesses a strong congenital element. It is first observed between the ages of five and ten. It is thought to affect boys more often than girls, in the proportion of 4–1; but, counting the cases observed with congenital hip dislocation, the disproportion is probably not marked.

It is often seen after reduction of congenital hip dislocation, occasionally on the sound side.

It is frequently bilateral, with symptoms only on one side.

In two cases a growth of staphylococcus has been recovered at operation from a softened area in the neck. One case showed a "necrotic" area, the other a "grayish" condition of the marrow. The pathological reports in these cases leave much to be desired. No evidence of an arthritis ever has been adduced.

It is hard to explain its causation by circulatory disturbances. Trauma probably does not cause it, but simply acts by spraining the distorted joint. Trauma often causes the symptoms but not the disease. Witness the frequent bilateral nature and the fact that almost invariably the *x*-rays show the complete and definite picture at the first examination. Then, in spite of treatment, or without treatment, the affection pursues a definite course, which no trauma would explain. This course may be modified by correct treatment, and the resulting deformity (coxa vara) avoided.

The areas of "destruction" (so-called), shown by *x*-rays, in the head, may possibly be areas of unossified cartilage. It is not likely that a destructive inflammation in the marrow of the head and neck could exist without symptoms, and without causing an arthritis, except as a great rarity. These irregular patches are standard in Legg's disease, occur with or without symptoms, and are present after healing apparently has occurred.

The typical roentgen picture consists in: (1) A flattening, broadening, and sometimes an apparent displacement of the epiphysis laterally, with one or more divisions of it and irregularity of ossification. (2) An irregularity or even segmentation of the cartilage between it and the neck. (3) Loss of bony structure in the neck, especially of its proximal and lateral part. (4) Irregularity in contour of the upper part of the femur neck. (5) Distortion of the head. (6) Enlargement of the trochanter (occasionally). (7) Irregularity of the acetabulum—not characteristic.

The astounding difference between the marked changes in the x-ray picture and the comparative insignificance of the symptoms and physical signs is characteristic.

The interesting query presents itself: Are all these changes due to some one special cause, or is one of them the essential change, and all the other changes its result?

The later picture shows a short thick neck, often coxa vara, and a distorted head. The chief symptoms, when symptoms are present, are limp and pain. Examination shows the limp, a prominent trochanter, and limitation, especially of abduction. Other motions may or may not be limited. A peculiar sign is the abduction at the hip when flexion is forced.

The affection seems to run its course in two or three years. Its most active period is one year. Even after all symptoms have subsided and a cure evidently has been obtained the x-ray may show an alarming picture.

Fibrous or bony union of the joint never occurs. The restriction of motion is mechanical.

In the past, Legg's disease often has been mistaken for tuberculosis, and cases of it have been quoted to swell the list of cures by some favorite treatment. The diagnosis as a rule is not difficult. Tuberculosis has more pain, more muscular spasm, greater restriction of motion and greater muscular atrophy. It shows radiographically more involvement on the shaft side of the epiphysial line and less in the head of the bone. It has not the same disproportion between the x-ray picture and the symptoms and physical signs.

As infection cannot be ruled out, any possible focus of infection in the body may be removed.

A good treatment consists in reduction of the deformity, if necessary under anesthetic, and the immobilization of the fully abducted hip in a short plaster spica until the process has run its course and the neck has firmly solidified. Crushing of the head is not to be feared.

Finally, as Legg described Perthes's disease three years before Perthes, the justice of calling it Legg's disease seems sure.

Grier, G. W., Pittsburgh, Pa. X-ray Examination of the Heart and Great Vessels. (*Interstate Med. Jour.*, Vol. XXVI, No. 3).

The author classifies the information obtainable by roentgen ray examination of the heart into two classes: 1, facts regarding the size, contour, and location of the heart; 2, facts regarding the pulsations of, and the influence of, respiratory movements on the heart.

In considering the size of the heart there are three possibilities, that it is too small, normal, or too large. The undersized heart is not often seen, the author only mentioning two cases, and both of these showed marked evidence of cardiac weakness clinically.

The normal heart varies in size between rather wide limits. For descriptive purposes he divides the normal heart into three classes: 1, the small vertical (drop) heart of the asthenic individual; 2, the medium sized and obliquely placed heart of the average sized individual; 3, the large transversely placed heart of the large individual or athlete.

The small vertical heart lies with its long axis parallel with the long axis of the body. It is found in long-chested, thin individuals and is supposed to indicate a predisposition to pulmonary tuberculosis. Its vertical position is probably due to an unusually long chest, just as the transverse heart in a fat person is due to a large chest. Deep inspiration has a tendency to convert the vertical heart into one of the oblique variety, while deep expiration tends to convert the oblique heart into the vertical type.

The medium sized heart varies considerably in size, shape and obliquity. The right ventricle is not seen in a roentgenogram, being covered by the diaphragm. The right auricle projects about one inch to the right of the spine. It describes a decided curve and blends above with the aorta and vena cava, and below with the diaphragm. The left ventricle forms the greater part of the shadow seen to the left of the spine. Above this shadow of the left ventricle is a small bulge representing the left auricle, above this another bulge indicating the pulmonary artery, while still higher one sees the descending aorta and aortic arch.

The large transverse heart rests with its long axis almost at right angles with the long axis of the body, this position resulting from a short chest and high diaphragm.

Hearts that appear too large are either hypertrophied, dilated, or there may be a pericardial effusion present.

The dilated heart may enlarge in any or all of its chambers. Enlargement of only the right side of the heart shadow means a dilation of the

right auricle, and occurs in the tricuspid lesions. An enlarged left shadow occurs in mitral and aortic lesions. In mitral lesions of long standing followed by decompensation the entire heart is dilated, while in early cases of mitral lesions the left auricle only is affected.

Pericardial effusion causes an increase of the heart shadow with obliteration of the normal curves identifying the various heart chambers. The heart shadow becomes roughly triangular, with the apex above and the base below.

The heart may be displaced from various causes, such as pleurisy with effusion, fibroid phthisis, tumors in the mediastinum, and subphrenic abscess. Fluoroscopic examination is an important aid in differentiating these conditions.

Aneurysm of the ascending aorta without involvement of the arch is occasionally seen as a sacculated protrusion of the right border. Large aneurysms of the arch are always continued into the ascending and descending aorta. Occasionally one sees an aneurysm of the innominate artery. The differentiation between the mediastinal tumor and aneurysm is very difficult at times, especially when the aortic pulsations are transmitted through a solid mass and give us the impression of an expansile tumor. An important differential point is that the borders of an aneurysm are always smooth and convex, while most solid tumors are irregular and knobby. Also in aneurysm the tumor can be seen, upon rotating the patient, to be continuous with the aorta, while enlarged glands lie mostly behind the shadow of the spine.

The differential diagnosis of thymus or substernal thyroid is easier, as the tumor lies above the arch. They might be mistaken for an aneurysm of the innominate artery, but here again the position is an important aid in differential diagnosis. The thymus lies in the midline, while the innominate aneurysm lies to the right of the sternum; also the borders of the thymus are more apt to be concave or straight than bulging, as seen in aneurysm.

MUELLER.

BOGGS, RUSSELL H. The Value and Limitations of Radium in the Treatment of Cancer. (*N. Y. Med. Jour.*, March 22, 1919.)

The extensive use and satisfactory results of radium therapy in the hands of men of recognized authority have caused a rapid disappearance of the skepticism formerly held in regard to radium. It is now generally regarded as a valuable adjunct in the treatment of malignancy and uterine hemorrhage. The chief factor that has brought radium into disrepute has been in permitting patients or physicians to expect a cure when only palliation could be expected. Palliation is not to be regarded unfavorably when it frequently prolongs life and adds greatly to the comfort of the patient. Aside from epithelioma the majority of malignant cases treated are hopelessly inoperable, and even so, an occasional clinical cure may be expected, but cannot be promised. A second important factor is the improper use of radium from lack of knowledge of the proper technic or in too small amounts. It may do harm if improperly used. Too little may stimulate and too large a dose may irreparably damage normal structures.

In epithelioma radium is most gratifying in its results. Epitheliomata are divided into four groups. The first comprises those lesions that may be cured by a single local application, as epitheliomata of the upper part of the face, unless bone or cartilage are involved, and especially in early lesions involving the eyelids. The second group includes cases which metastasize early to near-by lymph glands, and in which the local lesion is treated by radium and the glandular and lymph channel areas by massive roentgenization. In epithelioma of the lower lip the results obtained by this method have justified its use. When properly applied to early superficial cases ninety per cent of cures may be expected without producing any marked deformity. Squamous cell lesions require two to four times more radiation than the basilar forms. The central lower lip and chin are drained into the submental glands, while the submaxillary glands receive the lymphatics from the lateral portions. The submaxillary salivary glands are closely connected and there is an anastomosis between the lymphatics draining the two sides and the central portion of the lower lip. Furthermore, the deep cervical glands connect with the submental and submaxillary groups. All these facts must be borne in mind in administering the treatment, and each link in the chain carefully treated by roentgen rays. The sub-

mental and submaxillary glands when enlarged should also be treated by radium application. The third group comprises lesions in which radium and roentgen rays will give palliation only; and the fourth, those in which excision is advisable followed by postoperative radiotherapy.

Epitheliomata of the mouth and throat are more resistant than lesions of the skin. Some results of radium therapy are brilliant and others disappointing, but the results warrant at least the consideration of radiotherapy in every case, either alone, as anti- and postoperative procedures, or as a palliative measure. Roentgenization of the cervical lymph glands is imperative, whether they are apparently involved or not. Where extreme caustic power is not necessary for the primary lesion other methods such as electric coagulation may give better results. This has the great advantage of destroying tissue without the danger of serious hemorrhage. Sarcoma of the nasopharynx is more amenable to radium therapy than carcinoma, and large growths may be made to disappear in four to six weeks. In deeply ulcerating carcinoma sufficient radiation is given to produce a marked reaction, and when this disappears in two to four weeks either electric coagulation or a repetition of radium is employed.

In carcinoma of the uterus radium is indicated as a palliative measure for inoperable and recurrent cases and for operable cases with constitutional contraindications. When recurrence or metastasis takes place the patient has an interval of nearly or quite normal health as a rule and suffers much less than those not receiving radium treatment. In hopeless cases the discharge and hemorrhage are much lessened or disappear entirely. In primary operable cases, either anti- or postoperative radiation or both are advisable.

In carcinoma of the rectum and bladder the same favorable results from either the curative or palliative treatment are not obtainable. The epithelium of these structures will not stand the amount of radiation possible without harm to the healthy mucous membrane of the vagina. H. PANCOAST.

BECK, EMIL G., M. M., F. A. C. S., Chicago. Bismuth Paste in War Surgery. (*Jour. of the Minnesota State Med. Assn.*, Vol. II, No. 5, May, 1919.)

Errors in Technique.

1. The method is often applied indiscriminately, without control by radiograms.

2. The mixture, when injected, is not sufficiently liquefied to fill all the sinuses and suppurating cavities.

3. The bismuth is applied in cases in which either a sequestrum or infected foreign body is at the bottom of the trouble.

4. The injections are often kept up after the wound is sterilized and thus no chance is given for healing.

5. The instruments used are often improvised and unsuitable.

6. The bismuth mixture is very often spoiled by the accidental mixture of a few drops of water. (Syringes should be perfectly dry when used.)

The sinus or fistula is nothing more than a shrivelled abscess or abscesses. It leads from its opening on the skin or into the bowel to the place where the disease originated, and this focus of disease is often at a considerable distance from the opening or openings of the sinus. It is therefore inconsistent to try to eradicate the suppuration by only dissecting the sinus tracts. With the radiographic reproductions of the labyrinths or sinuses before us, an attempt to dissect the same would be absolutely hopeless.

If the focus from which the sinus originated is reached and disinfected, in practically all instances the sinuses will close up. It is therefore essential that when a fistula or sinus is injected with bismuth paste, it must reach the focus of the disease. If, through faulty technic, this is not accomplished, good results cannot be expected.

Indication

A. All sinuses resulting from chronic suppurative joint affections, tuberculous as well as non-tuberculous. This includes the sinuses especially after spondylitis and hip joint diseases.

B. Sinuses after osteomyelitis of long bones and flat bones, including ribs.

C. Sinuses resulting from suppurative diseases of parenchymatous organs, such as the kidney and other glandular structures in the body, including suppurative tuberculous glands.

D. Post-operative sinuses which sometimes remain after draining infected wounds.

E. Sinuses after empyema of the pleura or from lung abscess.

F. In cases of abscess and suppuration of the mammary glands.

G. In all infected wounds due to crushing injuries.

H. In infected and long suppurating war wounds due to shrapnel or bayonet injury.

It has already been tested in these and found most effective. The rapid accumulation of this class of cases due to the present war in Europe will furnish a tremendous amount of material for treatment.

I. In rectal fistula or pararectal abscesses.

K. By otolaryngologists in the treatment of suppurative antrum disease and accessory sinuses, as well as in the after treatment of mastoid operations.

L. By dentists in suppurative sinuses about the teeth and jaws and in pyorrhea alveolaris.

M. It has also been used by us in chronic endometritis.

N. In the prevention of sinuses by incising the cold abscess and injecting it with a five per cent bismuth paste.

Summary

To insure success in employing bismuth paste the essential points are summarized as follows:

1. One should make a correct diagnosis by all the methods at his disposal and corroborate the same with stereoscopic radiograms, before an injection is made.

2. Before attempting to employ this method one should acquaint himself thoroughly with the technic.

3. The proper instruments should be employed in order to carry out the technic correctly.

4. The patient should be kept under constant observation to prevent bismuth intoxication.

5. Examine the secretions from the sinus before the first injection, by slide and culture, and often by the inoculation of guinea pigs; then three days later test the sterilizing effect of the injection.

6. As long as the sinus contains microorganisms it should be reinjected but if it is found sterile, it should not be reinjected.

7. It is good practice to wait at least one week after the first injection before repeating it.

8. A stereoscopic radiogram of the parts affected should always precede the first injection, in order to detect the presence of foreign bodies. The shadow of the paste might make their presence obscure.

9. Following the injection a second set of stereoscopic radiograms should be taken in order to make a correct anatomical diagnosis.

10. In case a foreign body or sequestrum is present, the injection is useless, operation the only means.

11. Acute suppurative processes should not be treated with bismuth paste, only chronic suppurations, both tubercular and non-tubercular.

12. Bismuth poisoning may be easily prevented by using only small quantities or when large quantities are required they should not be retained longer than ten days, and the patient should be carefully watched.

13. Fecal fistula and other post-operative sinuses are very favorably affected by bismuth paste treatment.

14. A ten per cent bismuth vaseline may be used in cold abscesses. In practically all instances the secondary infection can be prevented, providing the technic is carefully observed.

Sittenfield, Maurice J., M.D., New York. Radiotherapy in Cancer: Summary of Six Years' Experience in the Treatment of Malignant Diseases. (*Med. Rec.*, March, 1919.)

The author laments the lack of uniform technique and the difference of opinion in regard to dosimetry. He enumerates the different devices of quantimeters, electroscopes and intensimeters, all rather too complex for common use. Also the different means of filtration, different thickness of the filters and focal distanes. He regards a three millimeter aluminum filter and a focal distance of six inches when possible as the ideal procedure. The difficult question of penetration he regards as simplified by the improved tubes.

In analyzing the results of treatment of cancer cases the author finds a marked increase of success since the advent of the Coolidge tube.

The final test for cure is the complete eradication of all cancer cells from the body. Many failures are due to the fact, as shown by Ewing, that while cellular and rapidly growing tumors are favorably acted upon, fibrous tumors of

long standing, as in Hodgkin's disease, are not responsive to roentgenotherapy.

A difficult factor to define is the constitutional resistance of the patient. There is no dependable index; the high percentage of lymphocytes might, according to Murphy, be indication of experimental cancer, but it does not hold true in clinical cancer.

A very important step forward in our fight against cancer is the closer cooperation between the surgeon and the roentgenotherapist; to get the best ultimate result, the treatment must start while the patient is in the prophylactic stage, that is, when the patient is recovering from the primary operation; in recurrent cases, the resistance to radiotherapy grows greater in time. In cachectic cases the greatest efforts must be used; there is almost always a psychological benefit derived from it.

As for selecting cases favorable for roentgenotherapy, the superficial basal cell epitheliomata are first, while the squamous cell epitheliomata do not react so readily.

PEER LUND.

SAYÉ, DR. L. Examen Radiologico de las Cavernas Tuberculosas del Pulmon. (*Archivos Españoles de Fisiologia*, Vol. I, No. 1, p. 105, Barcelona, Jan., 1919.)

In the preface to his article Dr. Sayé points out the enormous advantage for the clinicians to be able to compare the clinical findings with the very exact findings of the roentgenograms and thus base treatment, especially the pneumothorax treatment, more correctly. The importance of the fluid level in cavities is emphasized.

In the study of the cavities he has made the five following divisions: 1. Cavities of the usual type similar to those described by Bouchard. 2. Giant lobar cavities. 3. Cavities in formation or cavitation in the caseous stage. 4. Different anomalies of cavities. 5. False cavities.

1. *Cavities* of the usual type may either be very clearly defined by a thin wall with a horizontal line showing the fluid level or may also have distinct walls surrounded by either clear or infiltrated tissues. The cavity in the only slightly infiltrated tissues is the most frequent type and found in chronic fibro-caseous cases, while the cavities with sharply defined walls and dense infiltrations usually are seen in fibrous cases and are usually multiple.

2. *Giant cavities* involving an entire lobe are Dr. Sayé's second division; in these only the inferior border can be outlined, while the other walls appear contiguous with the pleura and the mediastinum. Aimard pointed out how easy it is to confuse the concave outline of the rib with the inferior outline of the giant cavity; but one ought always be able to see the broncho-vascular ramifications in the normal lung tissue.

3. *Cavities* in formation, giving the picture of a cavity formed by the breaking down of lung tissue, usually consist of an area in the middle of a shadow of infiltration with a ring shaped wall but instead of a clear space, the inside being perfectly filled with caseous matter and detritus; and these are rather harder to diagnose. Under this heading he also includes the multiple cavity formation described by Mantoux and Maingot as the "bread crumb" and "honeycomb" pictures. Another type under this division is the cavity apparently made up of a conglomeration of shadows and clearer spaces and found by autopsies to be a half formed cavity with only a fraction of the wall formed.

4. *Anomalies of cavities.*—The most frequent form is the cavity with the ringed shape roughened walls, and is usually situated in the parenchyma with very slight infiltration. Aimard has described these as being due to dry cavities without any signs of activity and apparently in the process of reparation; but the author proves that although their activity seems to be very slight there is a distinct focus which might flare up during a very slow evolution.

5. *False cavity* images or pseudo cavities where the lung markings and vessels in perfectly healthy parenchyma may assimilate ring shaped walls.

Other facts about tuberculous cavities have been demonstrated by means of the roentgen ray, as for example the greater frequency of cavities on the left side compared to the right; another important thing is the demonstration of the so-called clinically latent cavities.

The illustrations accompanying the article of Dr. Sayé are remarkable for their clearness and their well defined lung markings, and furthermore are well worth mentioning on

account of the rather unusual new method in pointing out the lesions and especially the cavities by outlining them on superimposed tissue paper, thereby greatly facilitating the work of the student.

P. M. Lund.

Vaughan, Roger T. Primary Suture of War Wounds. (*Surg., Gyn. &O bst.*, April, 1919.)

In discussing the examination of the patient before operation, he states:

"The use of the *x*-ray, either by plates or, more usually, the fluoroscope, is desirable if not always absolutely essential for the successful removal of foreign bodies. The army localization of foreign bodies has reached a high degree of development, and is practically always used in U. S. units when available. The experienced surgeon can follow up the track of the projectile quite successfully in many cases without fluoroscopic aid. But in cases where two projectiles enter through one opening or where the missile breaks up after entering the body and makes a Y-shaped track, the *x*-ray is indispensable. Furthermore, it often warns the surgeon in advance as to difficulties he will encounter in following the track at operation. In some cases it reveals the presence of a wound or fracture which clinical examination was not certain of or had missed entirely. In the case of simple penetrating wounds, however, where it is relatively easy for the surgeon to follow the track, the *x*-ray examination is sometimes omitted in French practice (though not in the U. S. service) to save time. This omission cannot be recommended in civilian practice.

"In the case of multiple wounds, such as hand grenades, buckshot, glass splinters and the like, a special fluoroscopic operating table is necessary equipment if all foreign fragments are to be removed within a reasonable space of operating time. Unfortunately, fluoroscopic tables are not available in many hospitals, army or otherwise.

"The points which are painful to percussion in the neighborhood of the wound must be examined more closely for evidence of gas. The fluoroscope or *x*-ray plates may reveal gas in the tissues. It may show very distinctly in the plates, infiltrating along the muscle planes and underneath the skin. Once seen in the *x*-ray, it can also be shown clinically. Such wounds must not be sutured primarily; but after primary excision and special care to remove all dead muscle, they must be left wide open with a light gauze dressing and, in favorable cases, may subsequently permit of secondary suture."

Batten, George, M.D., C.M. Presidential Address to Roentgen Society, November, 1918. (*The Journal of the Roentgen Society*, No. 58, Vol. XV, January, 1919.)

"Whatever electrons may be, whether rarefactions, kinks or whirls in the ether (and I believe that they are some sort of interruptions in the continuum of the ether, because that theory seems to be at present the most tenable, if for no other reason than that it gives the best explanation of gravitation that I have heard), yet they belong to the physical world. We can understand the possibility of evolution from these, forming first the simpler atoms, such as hydrogen and helium, and then the atoms of radium and uranium with their much greater number of electrons; the gradual formation of molecules and compounds, such as that common, but peculiar molecule of water, which has such remarkable properties, until at last we reach the very complex molecules of organic substances and the comparatively huge molecules that form the physical basis of protoplasm.

"We can realize, as Sir Oliver Lodge points out, that mere increase of size may produce certain properties impossible in smaller atoms and molecules. For instance, small celestial bodies cannot retain an atmosphere, because the maximum pace of travel of the gaseous atoms from their surface is greater than their gravity can control; but larger celestial bodies, from about the magnitude of our earth, can control the travel of these gaseous atoms and therefore retain an atmosphere of some sort.

"We can understand how the possession of an atmosphere allows an evolution to take place in living organisms, until at last conscious sentiment beings are evolved that can live and think.

"We know that still larger aggregates of matter, like our sun, retain the power of radioactivity and provide also the source of heat, light and electricity that enables life to continue on its planets.

"As far as we know at present, even among

atoms themselves radio-activity only occurs spontaneously in the very heaviest of the whole series: probably in the future we shall find that it does occur to a less degree in others, and some day we may find a means of breaking up the atom and using the great store of intra-atomic force, which at present we cannot do outside a vacuum tube.

Allowing that evolution of the purely physical forces can by their actions and reactions and by a process of evolution form a substance with immense molecules—that is, protoplasm, and that this substance exists in aggregates with or without a limiting membrane—can we believe that this aggregate, or cell, can by its mere size develop or attain to a new property, the property of life? The Monists, such as Haeckel and his disciples, say that it can, and that life is nothing more than a form of energy, inherent or immanent, in matter from the beginning, immanent, in other words, in those minute aggregations of moving electrons.

"If this is so, then when an aggregation of molecules of protoplasm constituting a living cell dies, this living energy must either cease to be or must be transferred into some other form of energy. If it is simply a form of motion of the same order as those causing heat and light, we cannot conceive of its ceasing to be, therefore we must believe it is transformed into some other form of energy. We can find no evidence of this happening.

"What then is Life? Whence did it come? We do not know, but I believe, as do most modern thinkers, that Life is something apart, and can exist apart from the Material Universe, from electrons, atoms and molecules, that it is in fact a separate creation of a different order altogether from the material world.

"This life comes into relation with certain aggregates of matter, makes use of, and exercises control of them and by causing re-actions in, and among them, imbues them with new properties, which are the manifestations of what we call Life in them, of growth, maintenance and reproduction. When this Life ceases to have this relation with matter, it returns with or without acquired individuality to the continuum whence it came.

"We all know that the motion of electrons and their aggregates, which gives rise to effects that we call heat, electricity and x-rays, can and do modify the growth, nutrition and reproduction of living cells.

"How can we picture to ourselves the effects of x-rays upon cells? Do these waves in the ether act upon the life which for the time being is in relation to the matter in the cell? I do not believe it, but rather that they act directly upon the movements of the electrons within the atoms of the cell, and that the life of the cell is able, more or less, to take advantage of this altered movement.

"If the action of x-rays is such as to accelerate the motions of the electrons in atoms and molecules without in any way altering their structure, then life can utilize these activities for increasing growth and reproduction. If, however, the action of x-rays accelerates or retards the motions of the electrons so that some of the electrons are discharged, and the protoplastic atoms are changed in constitution, then life may be less able to make use of these new combinations, and therefore growth and reproduction are less manifest, that is, they are retarded.

"Should the action of x-rays be great or prolonged it may cause such accelerating or retarding of the electrons, that the protoplasmic atoms are altered so much in constitution that life can no longer enter into relation with them or make use of them, then the cell dies.

"Although it may seem childish to say so from this chair, all this shows that Life is not Electricity, and Electricity is not Life, despite some statements to the contrary that are often seen, and not only in advertisements for quack remedies. The passage, for instance, of a nerve impulse along a nerve, although analogous to the passage of an electric current along an insulated wire, does not travel the same pace, does not obey the same laws, and is not, in fact, a passage of electrons along that nerve, though often associated with the passage of ions through the nerve or other tissues."

WHY NEW TRIAL WAS DENIED IN MALPRACTICE CASE (Campbell v. Peters. [Me.], 102 Atl. R. 881. Ref. *J. Am. M. Ass.*, Vol. 71, No. 10.)

The Supreme Judicial Court of Maine, in overruling a motion made in behalf of the defendant for a new trial, after the plaintiff had obtained a verdict for some sum not stated by the court, says briefly that this was an action brought by the plaintiff against the defendant for alleged malpractice in the performance of a surgical operation. The case came up on motion for a new trial on both the ground of liability and the damages awarded. On the question of liability arose the usual conflict of testimony between medical men when called to testify on the one side and the other of a medical or surgical case. The jury found for the plaintiff on this issue, and its verdict, if accorded the benefit of the well-established rules of law, should not be disturbed. Nor does the court think, under the testimony, that it would be warranted in cutting down the amount of the verdict. The jury is as much a part of the judicial system, under the constitution and laws, as the presiding justice or the law court. While this court might have a different judgment from the jury in a case, it is not authorized to substitute its judgment for the jury's, when the jury has exercised a judgment not so inconsistent with the most favorable interpretation the evidence will bear as to indicate bias, prejudice or improper influence.

A CORRECTION

May 11, 1919.

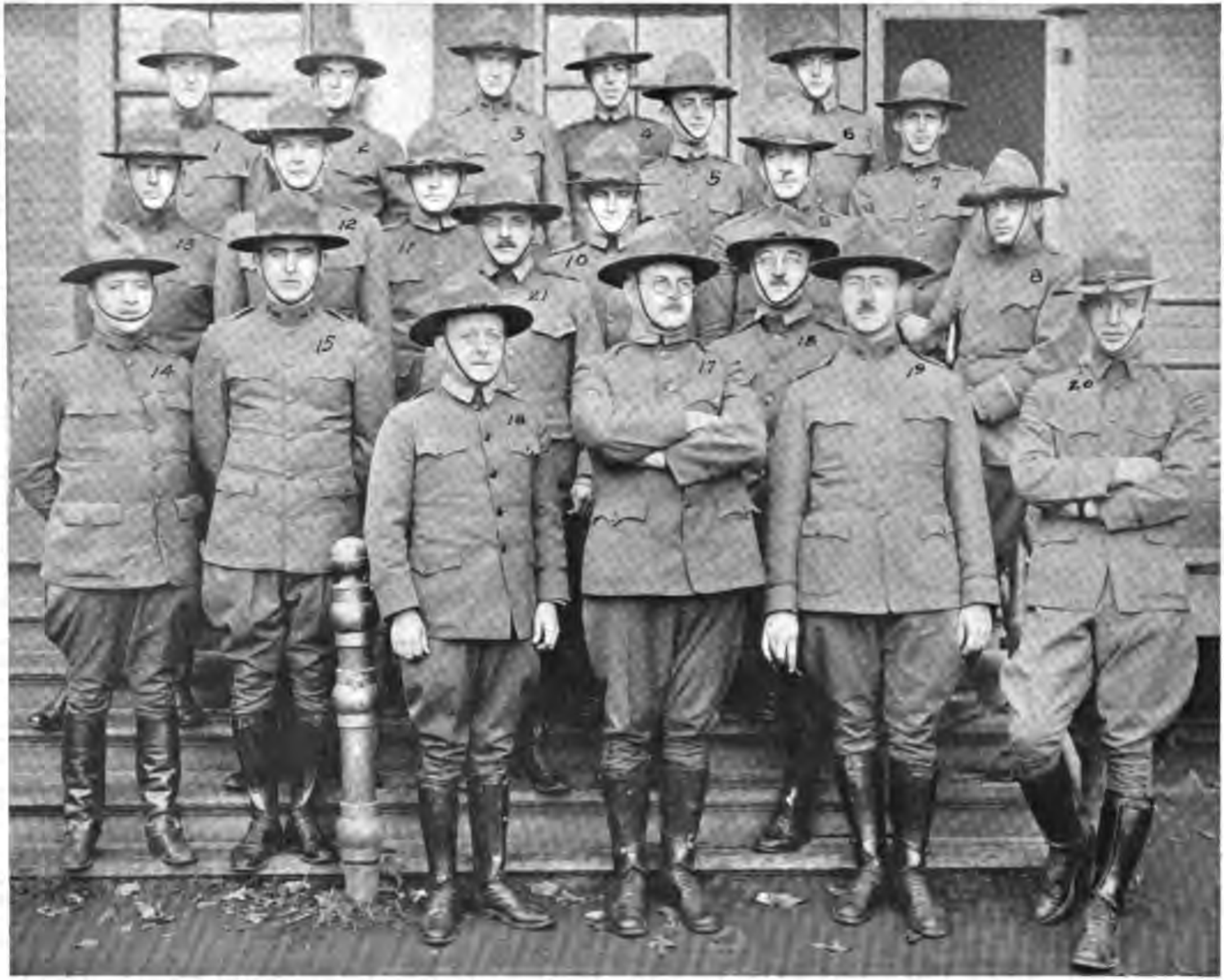
Dr. H. M. Imboden,
480 Park Ave.,
New York City.

DEAR DOCTOR IMBODEN:

In the April number of THE AMERICAN JOURNAL OF ROENTGENOLOGY, on page 192, there has been an error in the position of the cuts illustrating my paper on "Esophago-Tracheal Fistula." The cut labelled Fig. 1 is really Fig. 2, and vice versa. As they stand, the legends are meaningless.

Will you kindly call attention to the correction, in the next number, if possible.

Very truly yours,
ISAAC GERBER.



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THE CAMP GREENLEAF SCHOOL OF ROENTGENOLOGY

BY LIEUT. COL. WILLIS F. MANGES, M.C., U.S.A.

PHILADELPHIA

THE Camp Greenleaf School of Roentgenology was started on January 2, 1918, with Major Ralph W. Holmes, M. C., assigned as temporary director. On January 10, 1918, Lieut. Colonel Willis F. Manges, M. C., director of the school, arrived and took up the work according to the plan of the Surgeon General's Office.

The function of the school at this time was to select the medical officers best fitted for service as roentgenologists, and to give them a preliminary course of instruction in the following subjects: Principles of Interpretation; Anatomy (particularly of the bones and joints) as revealed by *x*-ray plates; Pathologic Changes; Standard Radiographic Positions (drill); Fluoroscopy; Stereoscopy; Report Writing; and the handling of unexposed plates.

This work was carried on in the *x*-ray department of the base hospital, which consisted of three rooms: a radiographic room, a fluoroscopic room, and a very small developing room. Captain J. C. Howard, M. C., was in charge of the laboratory and offered the school every facility and cooperation. He also served as assistant instructor prior to being assigned to overseas duty. Captains James W. Levering and H. B. McEuen were also assigned as assistant instructors. Capt. McEuen has since gone to duty in France. The space was very inadequate, but the clinical material was extensive, and the enthusiasm of the instructors, as well as of the student officers, was of a high degree. It was apparent that much could be accomplished in larger quarters, and it was further the early conviction of the director that, with adequate accommodation and equipment, there were many advantages here in favor of making this a school for a complete course of training, and even of its being the only school of its kind in the United States.

The director had prior to this conducted a school of military roentgenology in Philadelphia at the Jefferson Hospital where the laboratory was large, well equipped and the clinical material abundant. There were many advantages, but also many disadvantages. The director, for instance, was subject to almost constant interruption by the hospital staff; many of the patients objected to the student officers being present, and the equipment, while of the best, was not that adopted by the army. Then too, neither the instructors nor the student officers had any idea of military regulations, customs or courtesies, and there was therefore an entire lack of military spirit or atmosphere present. There were too many attractions outside of the school work, and the officers had to spend almost all of their pay in living expenses. The director found it difficult and at times embarrassing to keep private patients from interfering with his military duties, and after six months' experience was decidedly in favor of discontinuing the local schools and concentrating the work where the in-

struction could be standardized and the equipment would be of the type sent to the front.

Standardization of equipment was, of course, a most important matter and this was carried out to great advantage in connection with the school in New York; but after this task had been practically accomplished it was considered possible so to equip the school at Camp Greenleaf that it would possess all the advantages of the complete school at New York, none of the disadvantages, and many other advantages in addition to those in New York.

These thoughts were brought to the attention of Colonel Page, the Commandant, and Colonel Brooke, Chief Instructor, both of whom encouraged the director to present the proposition to Colonel A. C. Christie, head of the X-ray Division of the Surgeon General's Office. We were assured in turn of every support in the matter of development of the school.

Because of the crowded condition of the hospital extra space was difficult to obtain. During the latter part of March steps were taken to secure Post Barracks building "S" for the x-ray department of the hospital, but possession of this was contingent upon the completion of new ward buildings. Plans were drawn for the necessary building changes, and a schedule for the complete course of instruction was made out in every detail on the basis of a three months' course of instruction, graduating twenty-four medical officers each month, and twenty-four enlisted men per month after a two months' course of instruction. The matters of equipment and of the necessary increase in the teaching staff were left for discussion with Lieut. Colonel Johnston of the X-ray Division of the Surgeon General's Office, who came to Camp Greenleaf in May for this purpose. At this time a complete equipment list was made out, and a staff of instructors selected. We were informed that the plan would be carried out and that we would take over the work of the New York School just as soon as the building could be made ready.

FIG. 1. CAMP GREENLEAF SCHOOL OF ROENTGENOLOGY.

During the first week in June the director was ordered to report to the New York School to investigate the methods of teaching, and to select from the equipment there any apparatus that would be suitable for the school at Camp Greenleaf. The equipment of the elementary physics laboratory, consisting of six instruction units, and the equipment of the localization laboratory, together with other standard pieces of apparatus and some office furniture, etc., were selected.

In the meantime two rooms had been added to the original x-ray laboratory, which, with an additional machine, a table, and a bedside x-ray outfit, materially added to the teaching facilities. The classes of January, February and March were sent

to New York to complete their training, while the classes of April, May and June were held at Camp Greenleaf awaiting the arrival of the equipment for the new school to complete their technical training.

During April Capt. Frank E. Wheatley was assigned to the school as instructor in machine operation, and during June Major A. W. George, Capt. E. S. Blaine, Capt. Myron B. Palmer, and Capt. Livingston Middleditch, Jr., S. C., also reported as instructors.

The apparatus from the New York School left New York on June 28th, arrived at Camp Greenleaf on July 15th, and the localization laboratory, consisting of six complete units, was installed in temporary quarters so that instruction in localization of foreign bodies was started on July 17th. The elementary and advanced physical laboratories were installed in hospital tents and were ready for operation when electric current was first available on July 24th.

By working three sections a day the student officers of the previous classes had received their final instruction in machine construction, repair and operation, and in localization of foreign bodies, by August 6th, and their work was so arranged that the class entering the school August 1st could take up the regular assignments of the complete course.

FIG. 2. REAR VIEW, SCHOOL OF ROENTGENOLCGY.

Work in the tents and temporary localization laboratory continued throughout the time that the building "S" was being arranged for the x-ray laboratory of the hospital and for the permanent quarters of the school. These changes were practically completed by the middle of August.

No sooner had we entered the new school than we were called upon to take larger classes. The space and assignment sheet permitted of doubling the output, and it was decided to shorten the course to two months in order to hasten the supply of roentgenologists. In shortening the course, the more advanced clinical instruction was sacrificed rather than work in localization of foreign bodies, the machine course, and anatomy and position drill.

By the middle of September we were called upon again to double the number of student officers and enlisted men; or, in other words, to furnish one hundred officers and one hundred enlisted men each month. This required both additional space and a rearrangement of the assignments, so that fifty officers and fifty enlisted men could be taken into the school each two weeks. Accordingly the adjoining building, known as "T," was secured and fitted up for the purpose.

The teaching staff had to be enlarged each time the demands were increased and

to this end we were fortunately able to secure the services of Major Wm. H. Stewart to teach the roentgenology of bone and joint pathology, and to look after the details of all clinical instruction. Major A. W. George was transferred to Camp Devens. Major Percy Brown, who had been in active service in France for more than one year, came to the school early in September and delivered a course of lectures with a view of bringing to the instructors and student officers an intimate knowledge of the conditions at the front and to spur all to more enthusiastic effort. These lectures were a source of inspiration to all. Lieut. Charles A. Waters also came to the school as instructor in September after having been in active service in France for more than one year, and having seen all the conditions under which x-ray work had to be done in the war zone. In addition to his courses of lectures Lieut. Waters also directed the radiographic and fluoroscopic examinations of the hospital patients, in which capacity he succeeded Captain Myron B. Palmer, who was transferred to the Surgeon General's Office for duty. Notes of Lieut. Waters' lectures are appended. This close contact with one who had been at the front was a factor of the greatest appreciable value to the director as well as to the instructors and students. A number of changes were made in the schedule as a result of conferences with Lieut. Waters.

Instructors at all times were selected solely on their fitness to teach some particular phase of the work, and in the majority of instances were officers who previously had been student officers in the school. In this way the desired results were obtained without at any time keeping at the school large numbers of men who had had wide practical experience. Each instructor was given the opportunity of selecting his own assistants from the classes, and wherever it was possible enlisted men, or non-commissioned officers, or Sanitary Corps officers were used in the strictly technical or mechanical phases of the instruction; for example, in the developing room, physical laboratories, and mobile unit manipulation. The instruction to manipulators was given entirely by Sanitary Corps officers and enlisted personnel.

The curriculum of the school was at all times based on the idea that men were being trained to do the kind of x-ray work that was met with at the front, both in the forward hospitals and those farther from the fighting line. In this connection we followed the advice of Lieut. Colonel Case, Senior Consultant in Roentgenology, A. E. F. It was of prime importance that the officer should be able to operate properly any type of machine, and to keep his machine in operation even under the most trying circumstances, that he should know all parts of his apparatus thoroughly so as to be able directly to supervise the installation or dismantling and transportation. The instruction in development of plates was given with more intensity to the manipulators than to the officers.

The course in anatomy and position and exposure drill was looked upon as one of the very important features, since the whole subject of reports, whether of localization of foreign bodies, of fractures, or other lesions, is based upon an accurate use of anatomical terms, and knowledge of the appearance of the normal was considered essential to the easy recognition of the abnormal. It also afforded the opportunity to all the students of making practical application of the instruction they had just received in the machine course. This course was further augmented by fluoroscopy of the normal.

Localization of foreign bodies was taught just as thoroughly as possible with complete equipment and models containing foreign bodies. It was one of the most satisfactory features of the course as well as one of the most important.

Of the clinical subjects, most attention was paid to fractures and diseases of the bones and joints, especially the infections following war injuries. In addition to the

lecture course, in which carefully selected lantern slides were used for illustration, a large collection of original radiographs were studied by sections of the class under the guidance of Major Stewart and his assistants. Special consideration was given to the matter of report writing in this section work.

The instruction with reference to the chest and its contents followed very closely by means of lantern slides as well as by section work in the radiographic and view box rooms. The clinical material was at all times abundant.

The instruction in the diseases of the gastrointestinal tract and urinary tract was given by means of slides and in the radiographic and fluoroscopic rooms. No attempt was made to be thorough except in the matter of technique. This class of

FIG. 3. ENLISTED MEN PERMANENTLY DETAILED TO SCHOOL OF ROENTGENOLOGY.

1. J. D. Durham
2. E. P. Newman
3. O. C. Hamby
4. R. M. Groesbeck
5. Sgt. W. W. Bennett
6. F. W. Sweigert
7. E. Singley
8. Sgt. W. J. Taylor
9. Corp'l G. C. Friend
10. Sgt. W. E. Darling
11. Sgt. L. S. Uphoff
12. Sgt. J. W. Young
13. Sgt. Dunn
14. Sgt. H. J. Boudreau
15. Corp'l H. A. Dart
16. Sgt. C. Hustedt
17. Sgt. C. T. French
18. Corp'l C. E. Sampson
19. Wm. Tolly
20. T. J. Moffett
21. S. Goodman
22. Corp'l E. E. Schowalter
23. R. S. Schiller

the text of the U. S. A. X-Ray Manual, lantern slides being used largely for instruction in interpretation. The hospital furnished a large amount of lung material so that each student studied numbers of patients both fluoroscopically and by means of stereoscopic plates, or single plates taken at the bedside. The time allotted for this instruction permitted close attention only to the more gross lesions, such as fairly well advanced tuberculosis, pneumonic consolidations, effusions, pneumothorax, etc. The diseases of accessory sinuses, mastoids, and teeth were taught patients, however, furnished opportunity for a large amount of fluoroscopy and no occasion was lost to give the student officers opportunity to use the fluoroscopic apparatus. There were a considerable number of requests for gastrointestinal examinations, but very few organic lesions were found to be present.

All departments of the hospital were encouraged to request bedside examinations of patients too ill to be moved. This work was done mainly by the students under the supervision of a capable instructor. The results were of surprising excellence and

the number of patients examined per day was usually quite large. On one occasion Lieut. L. L. Rogers, chief instructor in bedside work, made nineteen very satisfactory radiographs of the chests of the same number of patients in twenty-nine minutes' time, and some of the patients were quite ill. This bedside work was thoroughly appreciated by all of the various chiefs of service, and was of the utmost value to the school as a means of instruction.

technique of extremities, and standard positions of other parts.

In addition to the instruction given to the students of the School of Roentgenology, courses of illustrated lectures or fluoroscopic demonstrations were given to the student officers of the various other schools at Camp Greenleaf. For example, two lectures a week were given to the School of Surgery, two to the School of Orthopedic Surgery, one to students in

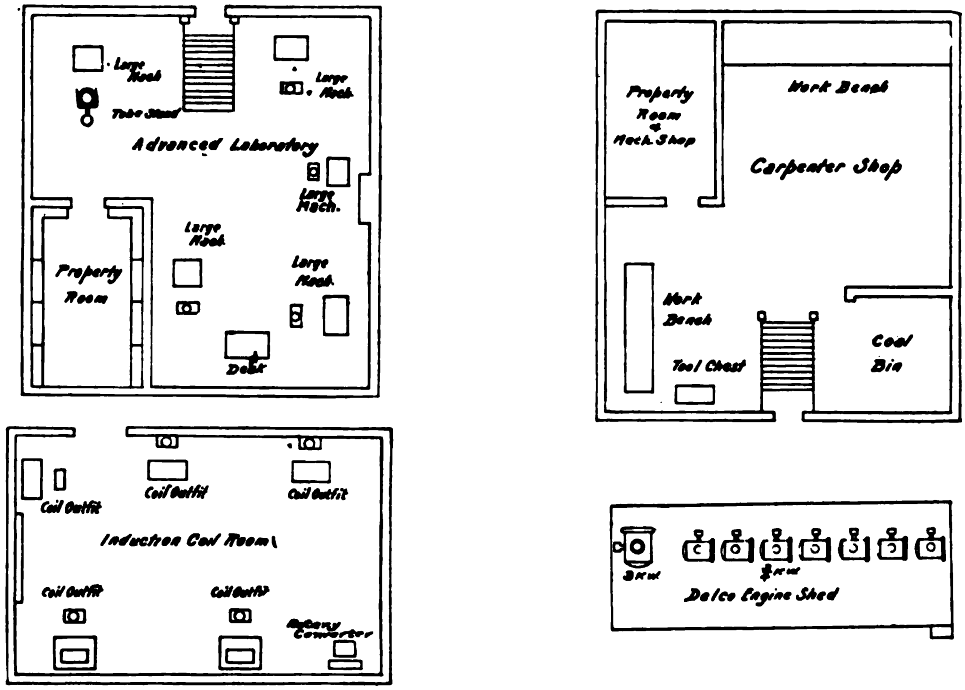


FIG. 4. BASEMENT ROOMS AND ENGINE SHED.

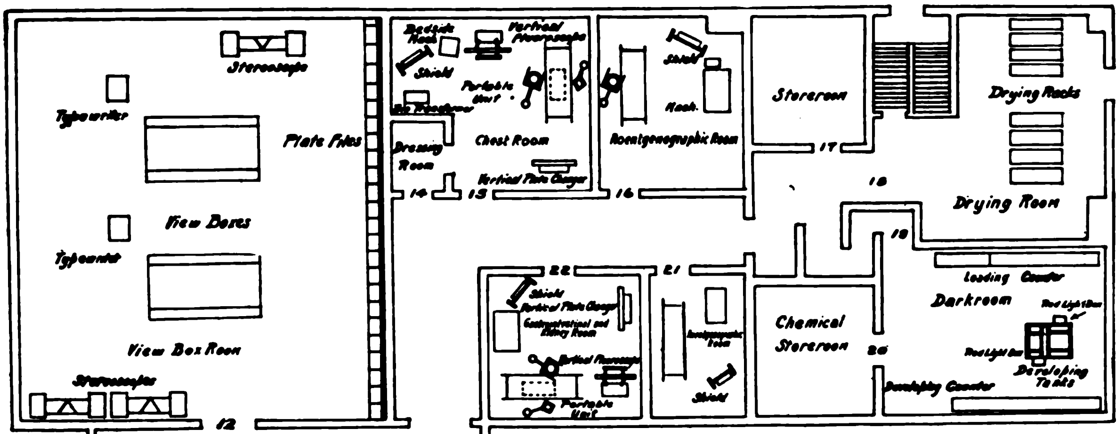
Instruction in the therapeutic use of x-rays was limited to individual training in operation of the Coolidge tube at a standard treatment exposure set of conditions, and in the use of filters, protection of surrounding parts, etc. No attempt was made to teach the application to any particular disease.

Instruction to enlisted men was limited to operation, care and repair of apparatus, developing room work, assisting in the radiographic and fluoroscopic rooms, the filing of records and plates, and exposure

Otolaryngology, one in Oral and Plastic Surgery, and occasional demonstrations to the School of Cardiovascular and Lung Diseases. The object of these lectures and demonstrations was to acquaint the several specialists with the sort of aid they might expect to get from the x-ray department, and to cultivate as much as possible a healthy spirit of cooperation. This matter of cooperation was further carried out by having at all times available a capable instructor who could take plates and records to the surgical operating rooms or

wards on occasions when such records might be of value in operations or in the instruction of the various classes. The instruction thus given to the various other specialties was started early in January, 1918, and was carried on throughout the year, we believe with a great deal of benefit to all concerned. In fact, this very feature was looked upon as one of the important reasons for having a very complete school of roentgenology at Camp Greenleaf.

The floor plan of building "S" was arranged with special attention to the hand-



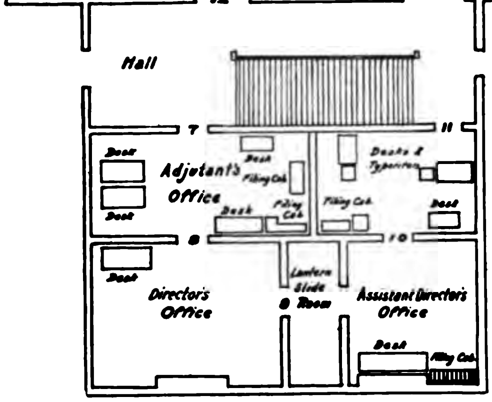


FIG. 5. FIRST FLOOR OF WARD "S."

ling of a large number of patients; or, in other words, primarily as an x-ray department of the hospital, and secondarily with a view to school purposes. Fortunately the plan worked well for both, the first floor and part of the second floor especially for the accommodation of patients, and the remaining part of the second floor, as well as two basement sections were more for school purposes. All changes were planned in such a manner that by the mere tearing down of the partitions and removal of apparatus the building would be in its original condition without damage. The partitions, ventilating, light-proof shutters, and most of the wiring in this building were done by outside contractors, but all the installations and a considerable amount of wiring were done by the officers and enlisted personnel of the school. All the work in building "T" was done by the school organization and furnished a great deal of very valuable training, especially to the students of the enlisted personnel.

Selection of student officers for the School of Roentgenology was always a matter of considerable moment to the director, and the process went through a sort of evolution in keeping with the development of the camp as a whole. During the first months a great deal of individual effort was necessary in order to find the officers who had had previous x-ray experience, and it was at times difficult to get and especially to hold them. The plan of calling for volunteers by means of notices read to the companies brought forth a large number of applicants, among them many who were not well fitted for the work, but the plan did have the advantage of bringing the opportunity to the attention of those who had had previous experience. The greatest objection to this plan was the

fact that it frequently turned out that the men selected had been retained at the Surgeon General's Office for some other service, and we learned of it only when orders came taking such men from the school. Later, the board of examiners, who examined all officers entering the camp in surgery and medicine, referred to the x-ray school all officers who claimed to have had any experience whatever in x-ray work, or who especially desired to take up the work.

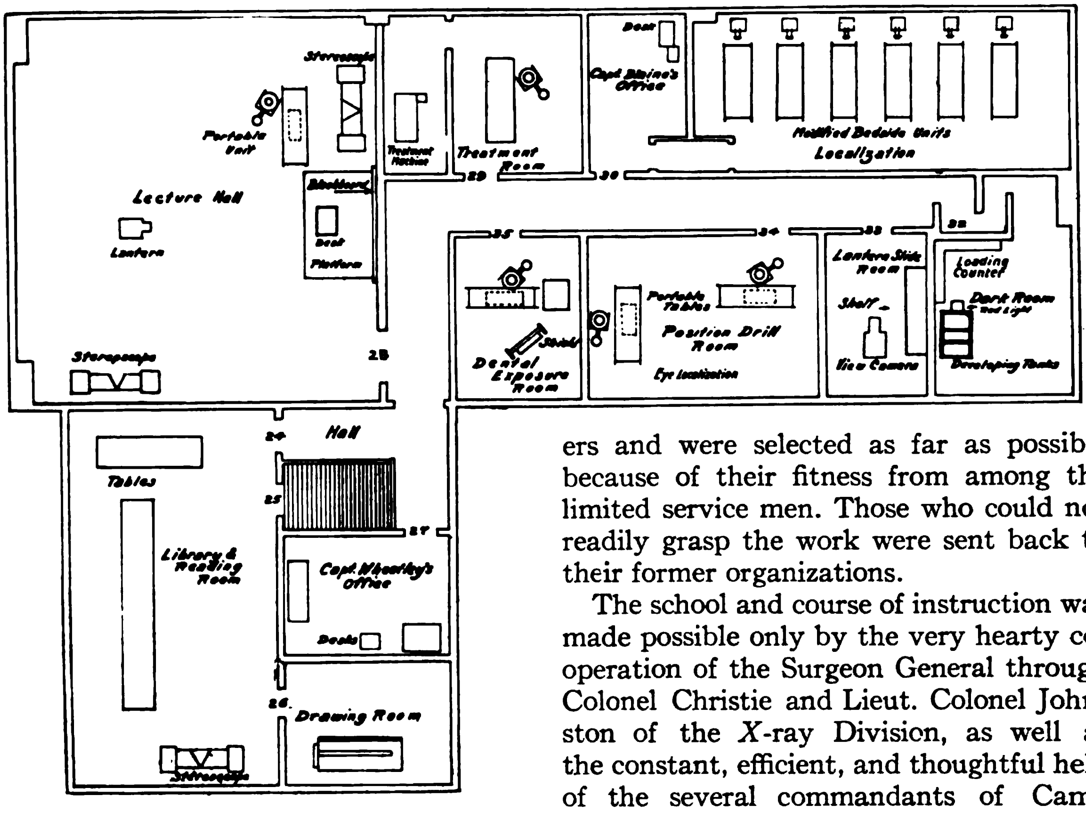


FIG. 6. SECOND FLOOR OF WARD "S."

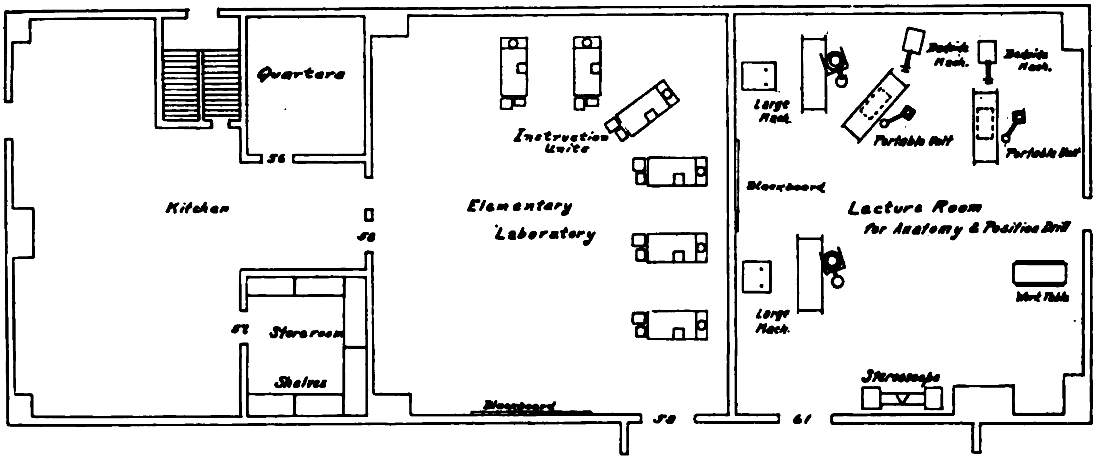
By this means a little more than half the desired number of students were obtained. In order to fill up the classes the president of the board of examiners selected from the files the cards of men who had passed good examinations in surgery, but who had not been taken up by the Surgical Chief. It was considered a matter of importance that the student roentgenologists should know surgery, for they were to be surgical assistants of the first degree of importance. With this class of officers, mostly under forty years of age, some of the most gratifying results were obtained. They were particularly adaptable to training for forward hospitals where the work was largely a matter of localization of foreign bodies and study of fractures. This plan was found to be the best obtainable and was fairly satisfactory.

The enlisted personnel were obtained entirely through various group commanders and were selected as far as possible because of their fitness from among the limited service men. Those who could not readily grasp the work were sent back to their former organizations.

The school and course of instruction was made possible only by the very hearty cooperation of the Surgeon General through Colonel Christie and Lieut. Colonel Johnston of the X-ray Division, as well as the constant, efficient, and thoughtful help of the several commandants of Camp Greenleaf and their respective staffs. The actual work in the school was carried on with the greatest ease and satisfaction because of the most enthusiastic spirit of loyalty, pride and cooperation that existed in the school organization. The director had the entire confidence of the X-ray Division, and in the matter of equipment, supplies, and assistants, was cared for with the utmost promptness. As stated before, the plan of the school was conceived during the time Colonel Page was commandant, and his encouragement, advice, and as-

sistance were responsible for much of the thoroughness of the idea. During the term of office of General Birmingham local conditions prevented rapid progress, but every encouragement and assistance were again forthcoming. It was, however, during the term of office of General Munson that the actual expansion was accomplished, and constructive work was done. The development at this stage was very rapid and was possible only because of the close personal interest and help of General Munson. During the final months, Colonel Bispham, who succeeded General Munson, gave the school every consideration and assistance. Colonel Roger Brooke, the officer in charge of all instruction work at the camp, was also greatly interested in the school and especially in the actual teaching plan. A physician, surgeon, and roentgenologist of real ability, as well as a regular army officer of the highest type, his interest in the school was of the utmost value throughout the entire year of our work. Thus we enjoyed the confidence and assistance of the entire camp organization throughout the year of the school's existence. In fact, the success of the school was due quite as much to the constant support of the commandants and their entire organizations as to the efforts of the school organization.

We believe that special mention should be made of the value of the military training given the students of the school, both before and during their course of instruction in x-ray work. Early in the year many of our students had been in the military training course for a matter of one or more months. Quite a number of them had been captains in their company organizations or had held some other office in the strictly military organizations. These men stand out in our minds as the best students, the men whom we could recommend for responsibilities. To our personal knowledge these men have all made good records in



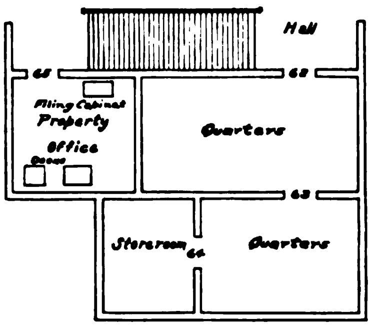


FIG. 7. FIRST FLOOR OF WARD "T."

active service, some of them under the most trying circumstances. Toward the latter part of the year less and less time was given to military training and the lack of interest in the school kept pace. During the last few weeks we were compelled to take in officers who had had practically no military training and it was difficult at times to maintain discipline in the different departments of the school, although we had much less difficulty with the x-ray classes

in this respect than we had with classes from the other schools. It is a conviction that a school of this size, under conditions requiring such an intensity of application, could not possibly be a success without the students having first been thoroughly instructed in the ideas and ideals of military discipline, and we feel this could not be accomplished in less than one month.

The Camp Greenleaf School of Roentgenology has accomplished a large amount of educational work. Primarily, this was done with the idea of helping to win the war. But it is worthy of note that the school has done much toward the elevation of the standard of x-ray work of the country, and this will be a lasting benefit in after-war days. We believe there never has been another school of roentgenology that has even approached this one in the way of equipment, facilities for teaching, teaching staff, or curriculum, and the probabilities are that it never will be surpassed. It was made possible by the rapid development of x-ray apparatus for the army. In fact, this development has been so rapid that we seem to have entered a distinct epoch in this branch of science, and it seems reasonable to believe that we will not see many radical changes in the matter of apparatus for some years. In short, the x-ray equipment of the United States Army is entirely satisfactory.

We feel it a duty to recommend that the school should be perpetuated in every detail except as to dimensions and duplications, and that all medical officers on entering the service in the regular army should have this course of instruction.

The whole scheme has worked well and we feel that the schedule as to the number of hours devoted to each phase of the subject represents the minimum that is practicable for obtaining efficient result. It is a strong conviction, however, that such a course should be given to men who are still young enough to be students, and within a short time after graduating in medicine, or preferably during their medical course.

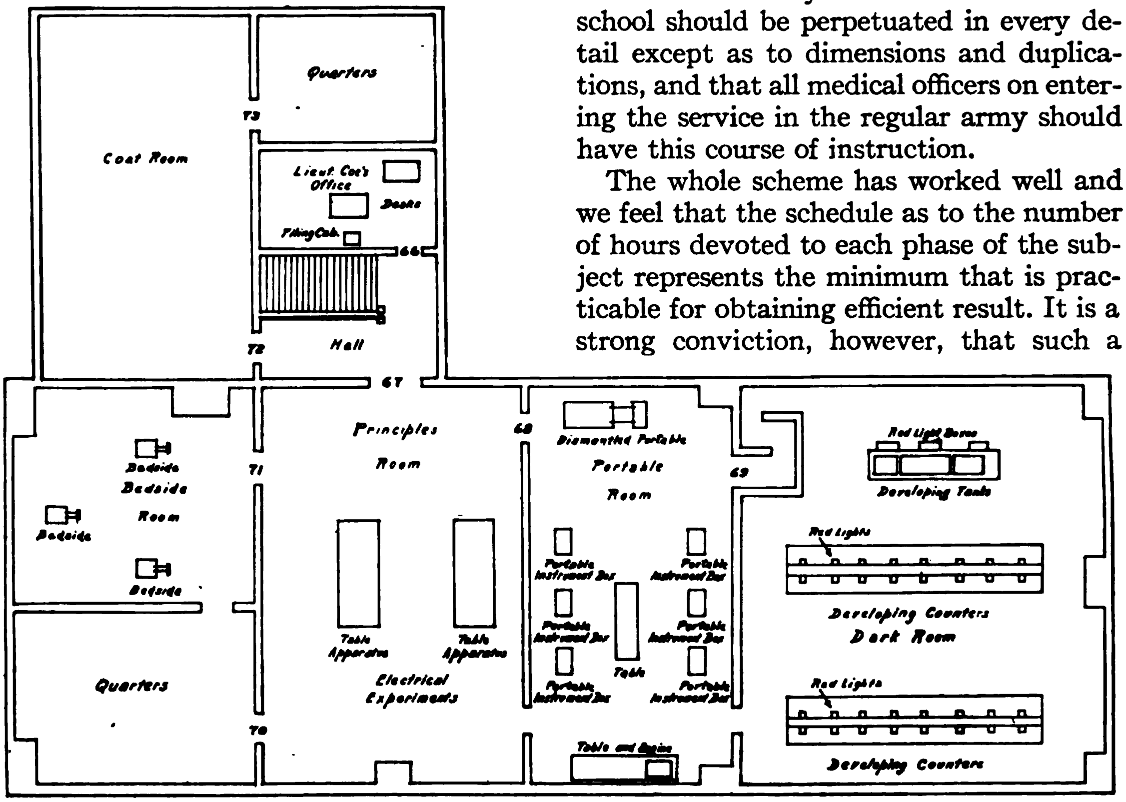


Fig. 8. Second Floor of Ward "T."

The history of the development of the Army apparatus will be recorded elsewhere. It has been a most important part of the scheme of preparedness, for the most part due to the genius of Dr. Coolidge. The plan of instruction in the physical and elec-

trical aspects of the course is to be credited almost entirely to Lieut. Colonel J. S. Shearer, S. C., U. S. Army, and the chapter on physics in the U. S. Army X-Ray Manual is the best evidence of the truth of this statement. All instruction in localization of foreign bodies, in the purely clinical subjects, and in the practical application of the whole has been, as before stated, based on the needs of the occasion, largely as expressed by Lieut. Colonel James T. Case, M. C., U. S. Army, Senior Consultant in Roentgenology, A. E. F. The development of the scheme of instruction up to its final stage has been due to the loyal and efficient cooperation of all those who have from time to time been a part of the teaching staff at the Camp Greenleaf School.

The entire result is, we believe, not the least evidence of the broadminded, generous and efficient policy of the Surgeon General of our Army.

OUTLINE OF COURSE IN *X*-RAY PHYSICS AND ELECTRICITY, ELEMENTARY AND ADVANCED LABORATORIES.

Instructor: Major Frank E. Wheatley, M. C.; *Assistant Instructors:* Lieut. F. H. Roepke, M. C., Lieut. J. B. Bond, M. C., 2d Lieut. L. S. Uphoff, S. C., 2d Lieut. W. W. Mowry, S. C.

Purpose of the Course.—This course is designed to acquaint medical officers selected for *x*-ray service with the various types of apparatus they may be called upon to operate when assigned to duty. While there is no intention to attempt to make electricians or physicists of them, still a considerable amount of time is spent upon the principles underlying the production of *x*-rays. This is deemed necessary in order that the men may have a basic knowledge that will enable them to render continuous efficient service, under the varying and often adverse condition of Military Roentgenology.

It is not necessary to enumerate the difficulties which may confront a man when on field service, away from technical or material aid. Throughout the course, attention is directed to measures designed to ***keep the work going*** under the most adverse conditions.

Outline of Instruction.—The quickest and most thorough way of learning is by doing. For this reason, laboratory work comprises the major part of this course. A source of danger, however, in laboratory work with a large number of men, is the probability that the men who have already had some training will do all the work, letting the men who most need the experience look on. To overcome this, the sections and apparatus are so arranged that each man must himself do the work under the supervision of an instructor. The only objection to this plan is that it demands more than the usual number of instructors and hence added expense. This objection is largely overcome by using selected enlisted men to act as assistants on the various units, all work being done under the direct supervision of a medical officer.

The laboratory work is given in several parts. First the men gain a fundamental knowledge of electricity by doing selected experiments on a unit called the "Principles of Electricity Table." Hereafter this unit is designated by the term "Principles Table." The class is given instruction in the operation of the rectifying type of machine on units called "Test Machines." Succeeding this, the following units are taken up: U. S. Army Portable Gas Electric Set, U. S. Army Portable Instrument Box, U. S. Army Bedside Unit, Induction Coil Outfit (gas tubes) and, finally, the various makes of Base Hospital Machines.

Each morning before the class goes into the laboratory, the lecture is given. The course of lectures is designed to parallel the laboratory work as closely as possible, and follows literally the text of the Manual with simple analogies for explanation. The last five lecture periods are devoted to review, and opportunity is given the class to clear up any points not made clear on first presentation.

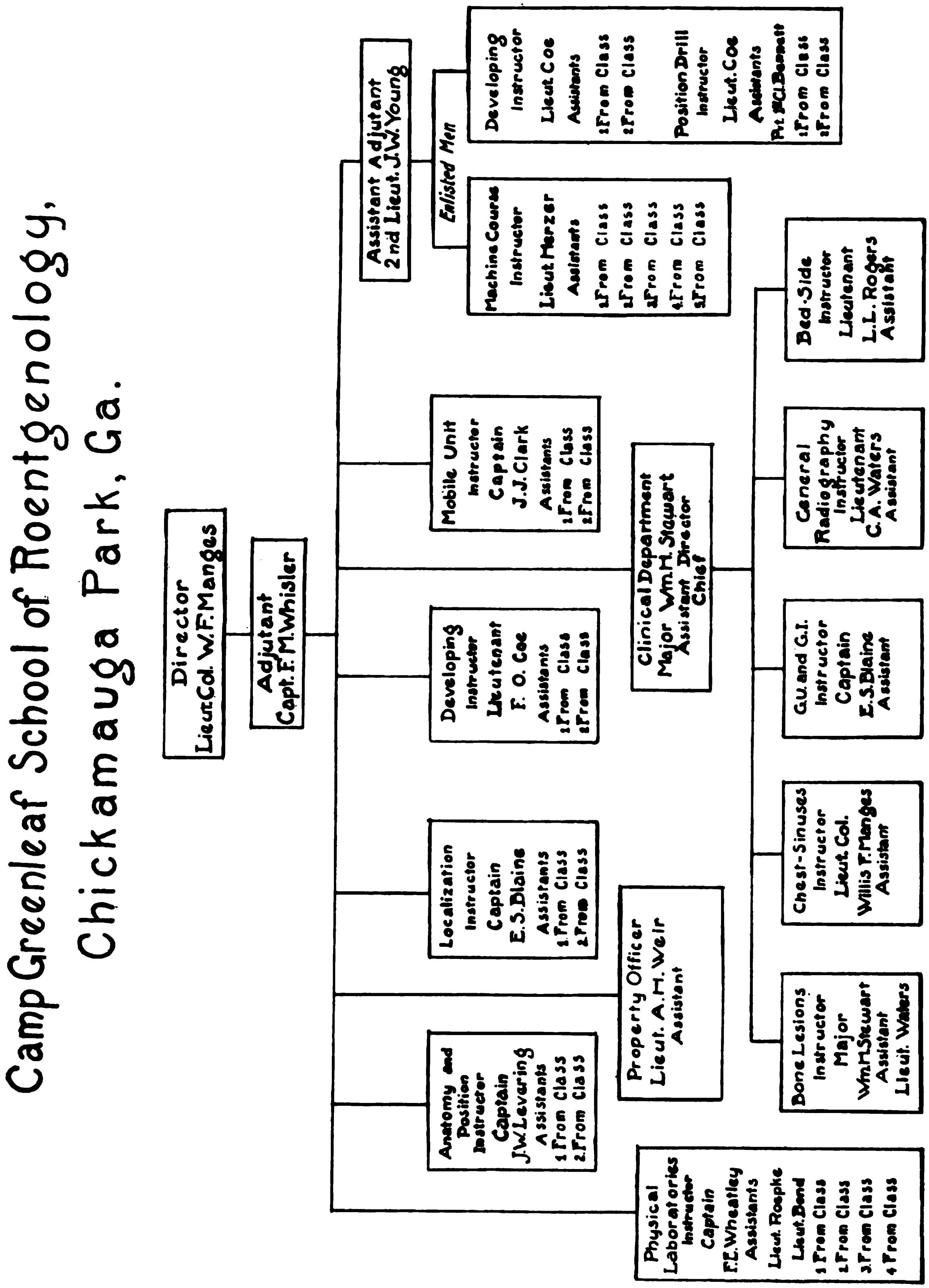


Fig. 9. Organization Chart.

Following is a résumé of the work done under each of the above headings.

The last day of the course is devoted to an interview between each man and an instructor. In this way, each man is "sized up" in respect to his practical application of knowledge gained in the course.

Principles Table.—This table has been designed to give men a conception of the physics of x-ray work.

Experiment 1 is an exposition of Ohm's Law. By means of resistance units and meters, the men are shown the relation between voltage, resistance and current.

Experiment 2 shows the presence of magnetic lines of force about a conductor carrying direct current, a compass being used for their detection.

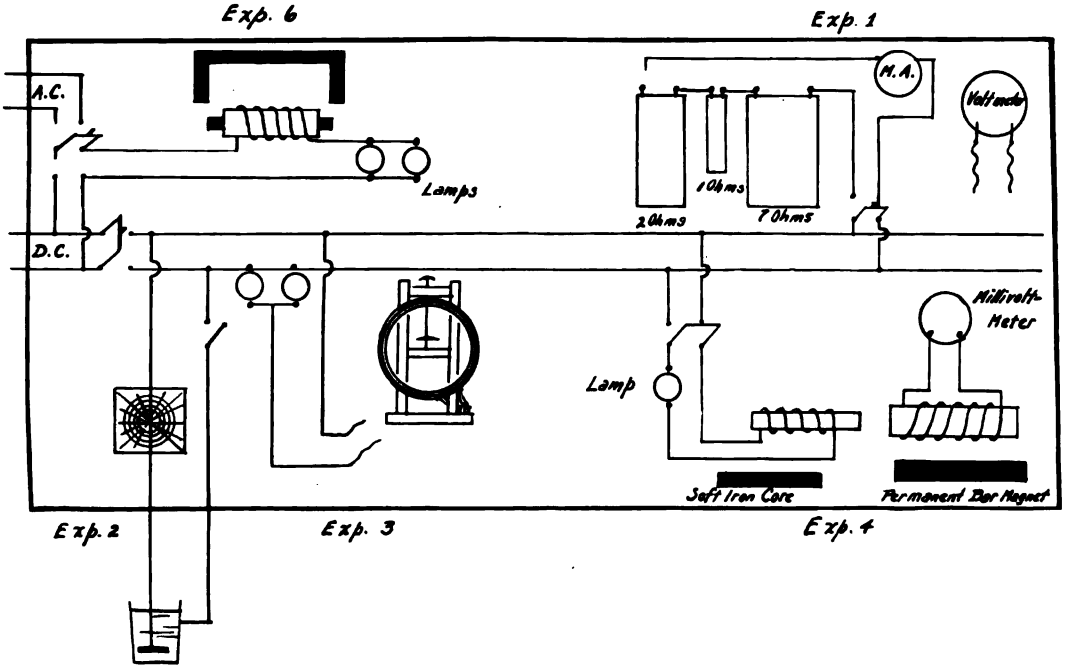
Experiment 3 shows the relation between the current in a conductor and the direction and intensity of the resulting magnetic lines of force.

Experiment 4 demonstrates the theory of induction, showing the multiplicity of methods which may be used for the production of induced voltage. Emphasis is laid on the fact that all the methods are simply ways to "cut" magnetic lines of force by a conductor.

Experiment 5 illustrates the closed core transformer. A model transformer is used to show the relation between primary and secondary in respect to voltage, amperage, and the number of turns of wire. The difference between autotransformer control and rheostat control is also explained.

Experiment 6 demonstrates self-induction. Attention is directed to its presence in every transformer and in choke coils, and the student is prepared for the explanation of the autotransformer.

Experiment 7. A model autotransformer is used to illustrate the fixed primary, variable secondary principle of autotransformers.



Wiring Diagram of "Principles Table."

Experiment 8. An autotransformer with taps, illustrates the commercial form of this appliance.

Experiment 9. Voltage drop along the line is illustrated by the use of lamps arranged along an inadequate conductor in which the load is varied.

Experiment 10. A toy magneto-motor arranged for A.C. and D.C. shows the

principles underlying the rotary converter.

Throughout the work on this table, the fact that we are training *x*-ray men is kept constantly in mind. Every opportunity to show the relation between the experiment and *x*-ray machines is made use of. In practice, this part of the course seems to have filled a long-felt want, as men who have had it approach an *x*-ray machine with a much clearer conception of its action.

Test Machines.—These are special units designed by Lieut. Colonel J. S. Shearer, S. C., and Capt. L. Middleditch, S. C., for use in the New York School of Military Roentgenology, and show clearly the basic principle of all *x*-ray outfits. They also are used to demonstrate the action of *x*-rays on a photographic plate under the actual conditions of operation.

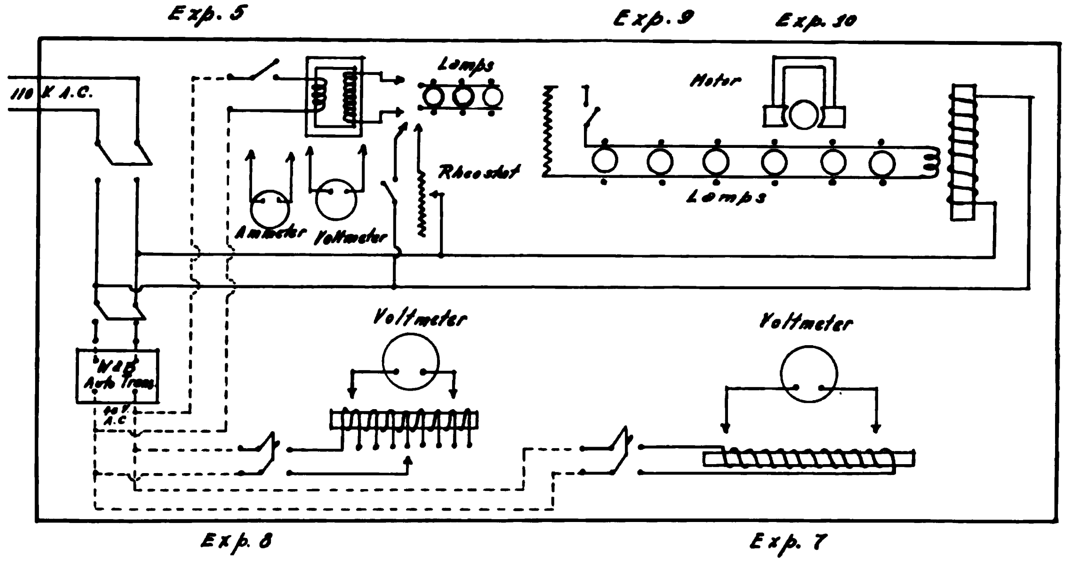
The first day in this laboratory is devoted to the study of the wiring and component parts of the unit. Diagrams are required to check up on the man's ability in this line.

The second day is devoted to rewiring the outfit, the wiring having been removed before class. After each unit has been inspected to avoid accident, they are operated with the improvised wiring.

The third day the machines are "charted" and attention is again directed to the difference between rheostat and autotransformer control. Then an experiment is performed which demonstrates the saturation point of a Coolidge tube.

The fourth day is devoted to experiments with test plates, showing the relation between photographic effect and distance between the tube and the plate—the inverse square law. Then the relation between photographic effect and the current is demonstrated.

The fifth day the relation between voltages as measured by spark gap and photographic effect is shown. Then a test plate is made in which the photographic effect is kept constant, but the factors of time, distance, voltage and current are varied. Computation from this experiment is made by the men previous to coming into class.



Wiring Diagram of "Principles Table"

The sixth day is devoted to an experiment showing the desirability of selecting the proper spark gap for radiography. Several exposures are made of a plaster-of-paris block containing a thick and a thin piece of brass. The resulting plate demonstrates penetration and absorption. After this a pin-hole picture of the focal spot of the tube is made.

The last day is occupied by operating the Coolidge tube with alternating current, preparing the men for the operation of the radiator type of tube used on the Portable

and Bedside Units. A test plate to illustrate "scattering" completes the work in this laboratory.

OUTLINE OF LECTURE COURSE

Text of Lectures follow the text of the *X*-Ray Manual.

1. Aims of the course. System of instruction. Electricity—Electron theory, charges, generators, conductors, resistance, meters, circuits, A.C., D.C., units.

2. Electricity—Ohm's law, magnetic lines of force, theory of induction, transformers (laws).

3. Electricity—Self-induction, autotransformers, requirements for *x*-ray tubes, high voltage, spark gap, *x*-ray transformer, *x*-ray machines.

4. *X*-ray machines, autotransformer, rheostat, filament transformer and regulator, milliammeter, spark gap, timer, surge resistances, synchronous motor and rectifier. Diagram.

5. *X*-ray Machines—Review. Wave motions, spectrum, *x*-rays—nature, behavior, uses.

6. Instructions and Precautions. Charts —purpose, autotransformer and rheostat charts. *X*-ray production—Coolidge tube, self-rectifying action of Coolidge tube, electron, voltage, target, focus (broad—fine), saturation.

7. *X*-ray Production—Relation of *x*-ray voltage and milliamperage, practical application of these relations. Relation of photographic effect to voltage, milliamperage, time and distance, laws.

8. Penetration, absorption, scattering. Gas engine of Portable Outfit.

9. Portable Box.

10. Portable Box and Bedside Unit. Exposure tables.

11. Base Hospital Machines—Type followed by all makes. Diagrams.

12. Base Hospital Machines—Wappler, Kelley-Koett, Campbell, Waite & Bartlett, Victor.

13. Base Hospital Machines—Review, rotary converter, D.C. machines.

14. Computation of line wiring. High tension wiring. Dangers—*X*-ray, electricity.

15. Gas tubes. Induction coil outfits. Interrupter. Valve tubes. Oscilloscopes.

ASSIGNMENTS AND APPARATUS

Principles of Electricity Table—(1 unit).
(3 days). Layout of experimental apparatus to illustrate electrical phenomena essential to *x*-ray.
Test Machines—(6 units).
(7 days). Assembled rectifying apparatus to teach principles of machines and Coolidge tubes.
Gas Engines—(4 units—1 dismantled).
(2 days). Units to teach operation and troubles of gas engines.
Portable Box—(4 units—1 dismantled, 3 engines for power).
(1 day.) Wiring and operation.
Bedside Unit—(3 units).
(1 day). Wiring and operation.
Coil and gas tube outfits—(4 units).
(1 day). Operation.
Advanced Laboratory—(6 units). (4 days). Wiring and operation of the various makes of Base Hospital Machines.

TABLE OF WORK ON THE VARIOUS UNITS

Principles of Electricity Table.
Three days' observation and performance of simple experiments to illustrate the essential electrical phenomena.
Test Machines.
Seven days: Tracing, rewire, operate, to show control and action of Coolidge tube and to illustrate technique of radiography.
Gas Engine.
Two days: Studying and operating. Attention is directed to dismantled engine, repair of common trouble, and detection.
Portable Box.
One day: Wiring and operation.
Bedside Unit.
One day: Wiring and operation.
Coils.
One day: Operation of coil and gas tubes.
Base Hospital Machines.
Four days: Operation, peculiarities of the various makes.
Interview. Last day of course.

Assignment Sheet. (Three Months Course) Camp Greenleaf School of Roentgenology

	Elementary Lab AM PM	Developing Room AM PM	Position Drill AM PM	Advanced Lab. AM PM	Anatomy and Interpretation AM PM	General Radiography AM PM	Chest AM PM	Gastro-Intestinal and Genito-Urinary AM PM	Dental AM PM	View Box Rooms AM PM	Sinus, Mastoid and Treatment AM PM	Bedside Unit AM PM	Bone Lesions AM PM	Localization AM PM	Photography and Filing AM PM
1st Week	AB CD	CD AB													
2nd "	CD AB		AB CD												
3rd "	wx yz	yz wx		AB CD	CD AB										
4th "	yz wx	x y	w z	CD AB	AB CD										
5th "			y x	wx yz		A w z3-5	B z1	C z4-6	D z2	ABCD					
6th "		w z		yz wx		B y x3-5	C x1	D x4-6	A x2	ABCD					
7th "			wx yz			C x y1-3	D w y4-6	A z1-3	B z4-6	ABCD					
8th "						D z w1-3	A y w4-6	B x1-3	C x4-6	ABCD					yz wx
9th "											A	B	CD	AB CD	
10th "											B	A	CD	AB CD	
11th "											C	D	AB	CD AB	
12th "											D	C	AB	CD AB	

ASSIGNMENT SHEET, 50 MEDICAL OFFICERS. (TWO MONTHS' COURSE.)

Week	Elementary Lab.		Developing room		Anatomy & Position Drill		Advanced Lab.		Localization		Bone Lesions		Bedside & Portable		General Roentgenography		Chest Gastro-intest.		Mastoid Sinuses Teeth	
	am.	pm.	am	pm	am	pm	am	pm	am.	pm.	am	pm	am	pm	am	pm	am.	pm.	am	pm.
1st	ab	CD	CD	ab																
2nd	CD	ab	ab	CD																
3rd.					ab	CD	CD	ab												
4th.					CD	ab	ab	CD												
5th									CD	ab	ab			CD						
6th									ab	CD	CD			ab						
7th.															ab	CD	CD			ab
8th															CD	ab	ab			ab

CLINICAL LECTURES

These lectures were given to the medical officers during their second month of the course. They were repeated monthly.

Date	9–10 A.M.	3:30–4:30 P.M.
1	Fractures	Reports and Records
2	"	Stereoscopy
3	"	Fluoroscopy
4	"	"
7	"	Heart and Lungs
8	"	" " "
9-16	Bone Pathology	" " "
17	Joint Pathology	" " "
18	" "	" " "
21	" "	Urinary Tract
22	Head and Dental	" "
23	" " "	" "
24-31	" " "	Gastrointestinal Tract

C and D, of six men each. The enlisted men are similarly divided, the sections being denoted by small letters, w, x, y and z.

Discrepancies between weeks and calendar months are taken care of by reviews and further study on the more important points. Thus the calendar month is always divided into four assignment periods. The school week consists of five working days, Saturday mornings being devoted to examinations on the past week's work.

The school day is made up as follows:

(a) For medical officers during their first month of instruction:

FIG. 10. TEST MACHINES, ELEMENTARY LABORATORY.

THE THREE MONTHS' COURSE

This assignment sheet is based on twenty-four medical officers reporting at the first of each month for a three-months' course and twenty-four enlisted men reporting at the middle of each month for a six-weeks' course. For the sake of clearness the assignments are filled out in skeleton form for only one class of each group. Succeeding classes would have exactly the same assignments, except four weeks later. The twenty-four medical men are divided into four sections: A, B,

8:30–10:30 Section work as assigned.
10:30–11:30 Lecture.
11:30– 1:00 Mess.
1:00– 2:00 Lecture.
2:00– 4:30 Section work.

(b) For medical officers during their second and third months of instruction:

8:30– 9:30 Lecture.
9:30–11:30 Section work as assigned.
11:30– 1:00 Mess.
1:00– 2:00 Lecture.
2:00– 4:00 Section work.

(c) For enlisted men throughout their course:

8:30– 9:00 Care of the apparatus.
9:00–11:30 Section work as assigned.
11:30– 1:00 Mess.

FIG. 11. FIRST VIEW, ADVANCED LABORATORY.

FIG. 12. SECOND VIEW, ADVANCED LABORATORY.

1:00– 2:00 Lecture.
2:00– 4:30 Section work.

The lectures are divided among the various subjects as follows:

(a) Medical men during their first month. (This series of lectures repeated monthly):

Physics and Electricity.........	15
Review quiz..................	5
Developing..................	5
X-ray Anatomy...............	10

Positions	5
	40

(b) Medical men during their second and third months. (This series of lectures repeated every two months):

Principles of Interpretation	1
Stereoscopy	1
Fluoroscopy	2
Fractures and bone lesions	15
Heart and lungs	10
Pathology (by a Pathologist)	10
Localization	5
Gastrointestinal	8
Urinary tract	2
Head and dental	10
Orthopedic	5
Therapeutics	2
Reports and records	2
Duties of the roentgenologists	1
Miscellaneous	6
	80

(c) Enlisted men. (This series of lectures repeated monthly):

Physics and Electricity	15
Review quiz	5
Dark room work	5
Handling of patients	2
Records and filing	2
Duties of the manipulator	1
	30

FIG. 13. "PORTABLE UNIT" ROOM. NOTE DISASSEMBLED ENGINE ON TABLE AT END OF ROOM.

The following notes are explanatory of the headings of the assignment sheet:

Elementary Laboratory: This laboratory is intended to give a fundamental knowledge of the *x*-rays and the means of their production. The apparatus is so arranged that all of the working parts and wiring are exposed to view, and the student learns the fundamental principles of any standard *x*-ray machine. He gets a great deal of practical experience in operating the machine and in making experimental plates before he is permitted to make a single exposure of the living subject. The equipment of

this laboratory is very complete and permits of intensive, individual instruction.

Advanced Laboratory: This laboratory is designed to supplement the elementary course by making the student familiar with each of the several standard Army machines. He learns the special features of each type of apparatus and the proper operation of each. Emphasis is laid on the matter of finding and *overcoming* the usual troubles which may occur in the use of these machines under military hospital conditions.

FIG 14. PORTABLE UNIT ROOM. CONTENTS OF PORTABLE INSTRUMENT UNIT, ASSEMBLED ON TABLE AT END OF ROOM. OPERATES EITHER ON ENGINE OUTSIDE, OR ON A. C. LINE OF BUILDING.

Developing Room: The developing room is so designed that each student receives individual instruction and practical experience in the handling and mixing of developing materials and in the handling and developing of plates and films. This work will be done under the supervision of an instructor experienced in developing room work.

Position Drill: In this room the students are drilled in the adjustments of the tube and the plate to the anatomical part in the standard positions for exposure. The students in turn assume the part of the patient, but they are not exposed to x-rays. Emphasis is laid upon the proper handling of wounded patients and the means of supporting injured parts.

Anatomy and Interpretation of the Normal: During this assignment the students are given a course of instruction and review on the bones, joints, and regional anatomy as revealed by the x-ray plate. Selected

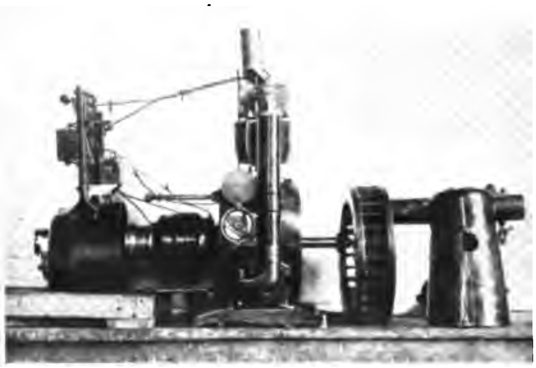


FIG. 15. DELCO ENGINE DISASSEMBLED EXCEPT AS TO WIRING.

plates of normal parts are used as a basis of interpretation of the normal anatomical

shadows, as revealed by plates made in standard positions.

General Radiography: Chest: Gastro-intestinal and Urinary tract: Dental: Sinus, Mastoid, and Treatment: At this point in the course the students are assigned to these various radiographic rooms in smaller groups and apply the instruction they have

FIG. 16. DELCO ENGINES. NOTE LEADS FROM ENGINES TO SECOND STORY.

FIG. 17. COIL ROOM. PHOTOGRAPH SHOWS THREE OF THE FIVE INDUCTION COIL OUTFITS. LARGE ROTARY CONVERTER IN CORNER SUPPLIES DIRECT CURRENT.

received up to this time. In these rooms under the supervision of an experienced roentgenologist the student actually does practical radiographic and fluoroscopic work, adjusting the patient, making the exposure, and reporting the x-ray findings in the case.

View Box Rooms: The fluoroscopic and radiographic work occupy one section period of each day, the other being given to study of the plates made, as well as of selected plates of lesions of various parts of the body. This plate study is done under assignment to the view box rooms.

Bedside Unit: During this assignment the student officers are required to go from ward to ward, making the necessary fluoroscopic bedside examinations and also radiographs of fracture cases that cannot readily be moved from their beds. This work is done with the standard Army Bedside X-ray Unit.

Bone Lesions: The work in this assignment is to be done in one of the view box rooms and includes a study of selected plates of actual bone lesions with special attention to fractures and bone and joint infections.

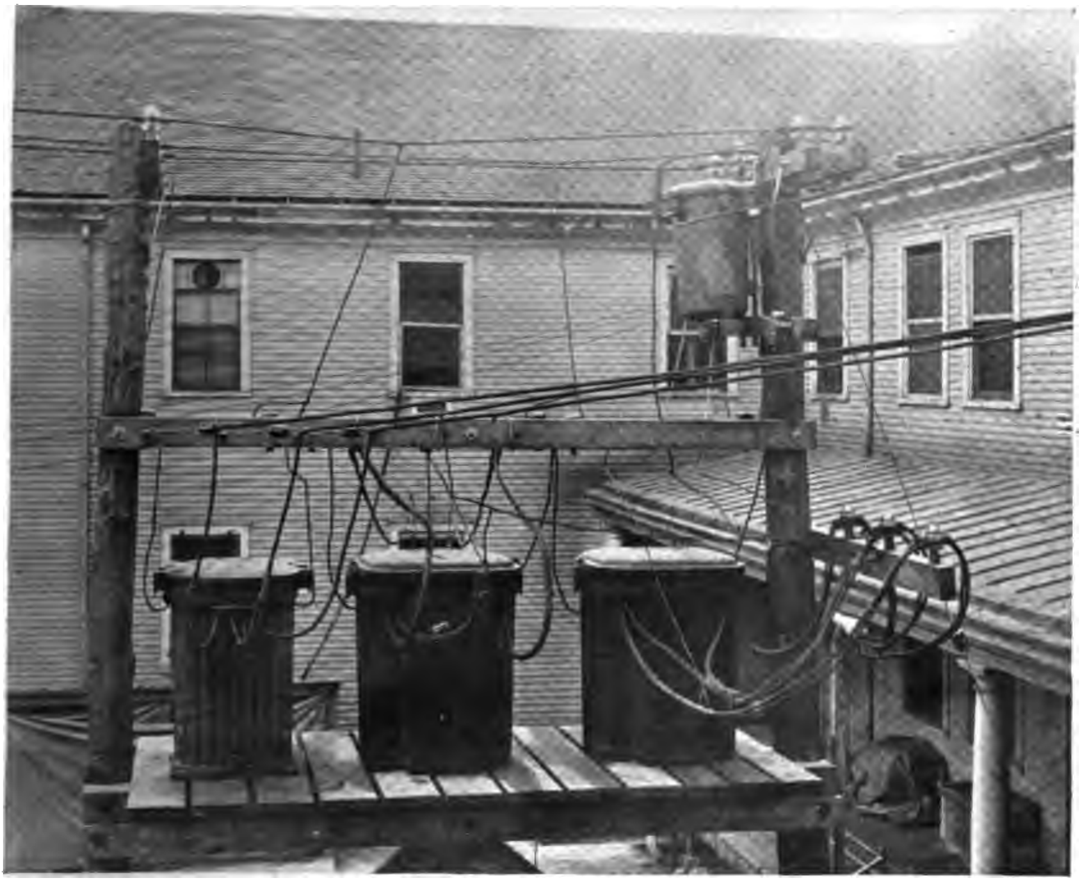


FIG. 18. STEP-DOWN TRANSFORMERS SUPPLYING POWER TO THE SCHOOL.

Localization: During this assignment the medical officers are given individual instruction and drill in the use of the methods of localization that have been adopted as standard. The time allotted for this instruction in this school is twice as long as was given in former schools elsewhere.

Photography and Filing: This room is devoted to meeting the actual needs of the school in the way of making identification

photographs of the students and in making lantern slides for teaching purposes. A selected group of students from among the enlisted men will receive advanced instruction in photographic and developing room work. Another group will be assigned to filing plates and the keeping of records, becoming especially familiar with this part of the manipulator's work.

THE TWO MONTHS' COURSE

Outline of Instruction in Developing and Photography

Instructor: 2d Lieut. Fred O. Coe, S. C.; *Assistant Instructor:* Sgt. Walter W. Bennett, Med. Dept.

INDIVIDUAL LABORATORY EQUIPMENT

(To be checked during the first period.)

2 4 x 5 trays, 1 10 x 12 tray, 2 1-litre bottles, 1 thermometer, 1 hand towel, 1 negative rack, 1 8 oz. glass graduate, 1 16 oz. glass graduate, 1 Florentine flask, 1 black oilcloth apron.

FIRST PERIOD. *Dark Room Procedure. Loading Drill*

1. Inspection of Dark Room in Ward S.
2. Students take places assigned in 1–32. Check equipment.
3. Demonstration of leading photographic material by instructor.
4. Loading drill:
    1. Plate into envelope and carrier.
        a. Student opens plate boxes.
        b. Loads plates into envelopes.
        c. Examination instructor.
        d. Unloads plate.
        e. Loads into developing rack.
        f. Replaces plate into box.
    2. Double-coated film into envelope.
        a. Into envelope, same procedure as above.
        b. Into exposure holder, same procedure as above.
    3. Dental Films.
        a. Unwrap package and load into holders.
    4. Plate into cassette, demonstrated by instructors.
        a. Cassette without screen.
        b. Cassette with screen.
    5. Film into cassette, demonstrated by instructor.
5. Load plates required for exposure drill.
6. Load plates and films required for week's work.

Material Needed: For each student, box with plate, same with film, dental film, core plate developing rack, film developing rack, dental film holder, envelopes, film exposure holder, plates to be loaded for exposure drill and for week's work, material from exposure drill to be developed. For each instructor, cassettes, plates and films.

SECOND PERIOD—*Dark Room Procedure*

1. Talk on mixing developer and hypo, covering:
    a. Personal cleanliness.
    b. Cleanliness of utensils.
    c. Care in getting right amounts.
    d. Tables of weights and measures.
    e. Saving of test lot (1 pint each) of developer and hypo.
2. Calculation of amounts necessary for 1 gal. developer and 1 gal. fixing bath.
3. Each group of sixteen students to prepare 1 gal. fixing bath and 1 gal. developer (give each of six some water in flask and let each put one chemical into solution).
4. Each student takes 1 pint of developer and 1 pint of fixing bath and labels bottle.

Material Needed: Chemicals weighed out for 1 gal. developer.
Same for 1 gal. fixing bath.
Distilled water in water pails.
Labels.

5. Demonstration of action of ingredients in developer and fixing bath.
    a. Following solutions to be made up separately, each of strength of normal developer.
        1. Metol.
        2. Sodium sulphite.
        3. Hydrochinon.

* Many valuable suggestions were made by Mr. Willard B. Hodgson.

4. Sodium carbonate.
5. Potassium bromide.
6. Hypo.
7. Sulphuric acid.
8. Chrome alum.

b. Experiments with developer.
1. Exposed film in each. Action watched.
2. Exposed film, metol and sodium sulphite.
3. Exposed film, metol, sodium sulphite and sodium carbonate.
4. Exposed film, hydrochinon and sodium sulphite.
5. Exposed film, sodium sulphite and sodium carbonate.
6. Exposed film, sodium sulphite, sodium carbonate and KBr.
7. Exposed film in each of the following at the time:
   a. Developer complete except for the KBr.
   b. Developer complete.

c. Experiments with fixing bath.
1. Hypo and unreduced film.
2. Hypo and reduced film.
3. Hypo and sulphuric acid.
4. Chrome alum and sulphuric acid.

THIRD PERIOD—*Dark Room Procedure*

1. Talk on plate identification covering:
   a. Writing on plate with lead pencil.
   b. Use of lead numbers.
   c. Making numbers from fuse or copper wires.
   d. (Use of control spot in developing).

   Lecture on judging development.
2. Demonstration by assistant instructors of correct development, each student developing four plates and two films correctly exposed (of a hand).
   Procedure:
   a. Demonstration by instructor.
   b. Each manipulator gets developer, water, fixing bath, etc., ready. Temperature of developer 65° F.
   c. Turn on ruby lights. Turn off white lights.

1. FIRST PLATE: *Normal Development*

1. Unload plate.
2. Mark plate with name, *station*, section.
3. Start development. Instructor watches time.
4. 1 minute. View by reflected and transmitted ruby light.
5. 2 minutes. View as in 4.
6. 3 minutes. View as in 4.
7. 4 minutes. View as in 4.
8. 5 minutes. Remove from developer, rinse in water, place in hypo.
9. Turn on white light at once, student watching progress of fixation. Wash and dry when completed.
11. Each plate examined.

2. SECOND PLATE: *Corrected Development. Independent Work*

1. Information to manipulators that it is correctly exposed.
2. Turn off lights and let them develop, not knowing time. At end of eight minutes turn on white lights and let them see results.

3. FIRST FILM: *Normal Development as in First Plate*

4. SECOND FILM: *Correct Development as in Second Plate. Independent Work*

5. THIRD PLATE: *Warm Developer*

Have developer warmer than normal. Give normal time. Note results.

6. FOURTH PLATE: *Cold Developer*

Have developer colder than normal. Give normal time. Note results.

Materials: 4 x 5 plates and 2 x 5 films, all correctly exposed. Method for

cooling and warming solutions. Each manipulator uses developer prepared during preceding day.

FOURTH PERIOD: *Dark Room Procedure*

1. Review on judging development.
2. Practice in developing and judging development.

FIRST PLATE. *Development Underexposure*

Put underexposed plate in developer. Observe time at which image shows up. Develop to normal time and observe results. (Immerse again into developer and give two minutes over normal.) Remove to fixing bath.

FIRST FILM. *Underexposure*

Procedure same as with First Plate.

SECOND PLATE. *Overexposure*

Develop to correct density regardless of time necessary.

SECOND FILM. *Overexposure*

Same procedure as with Second Plate.

FIG. 19. MAIN DARK ROOM.

THIRD PLATE. *Exposure unknown*

Develop to density giving diagnostic value.

THIRD FILM. *Exposure unknown*

Develop to density giving diagnostic value.

3. Put plates to wash and let them wash during quiz. Put to dry before leaving room. This procedure to take place each day.
4. QUIZ:
   1. What do you understand by an underexposed plate?
   2. What is an overexposed plate?
   3. What difference in the development of an underexposed plate?
   4. How would you judge correct development?
   5. Why is development apparently carried beyond the density desired in the finished negative?
   6. What are the stages in the appearance of the image in a normal exposure?

MATERIAL NEEDED FOR EACH MANIPULATOR

1 underexposed plate, 4 x 5 size, 1 overexposed plate, 4 x 5 size, 1 unknown exposure plate, 4 x 5 size, 1 underexposed film, 4 x 5 size (duplitized), 1 overexposed film, 4 x 5 size, 1 unknown exposure film, 4 x 5 size.

SIXTH PERIOD. *Dark Room Procedure. Tank Development of Miscellaneous Material*

FIG. 20. DEVELOPING COUNTERS. NOTE INDIVIDUAL EQUIPMENT COMPLETE. COUNTERS WHITE. ALL LIGHT IN THIS ROOM WHITE AND RED, UNDER CONTROL OF INSTRUCTOR BY MEANS OF WALL SWITCHES.

FIFTH PERIOD: *Dark Room Procedure. Tank Development*

1. Brief talk on tank development.
2. Practice. Manipulators, in order, from each table, develop a film or plate. In the meanwhile all manipulators not at tanks can ask questions and be quizzed by the instructor. Quiz questions for week's work to be gone over.

MATERIAL NEEDED

Tank units. 6 gal. developer made with powders and 6 gal. fixing bath made with powders for each set of tanks. Each manipulator should have: 1 normally exposed 8 x 10 (or larger) plate and film, 1 underexposed 8 x 10 (or larger) plate and film, 1 overexposed 8 x 10 (or larger) plate and film.

Procedure—Give students material and let them proceed to develop with greatest speed and accuracy, having in view diagnostic value of negatives. Each group of six men to mix developer and fixing bath.

MATERIAL AT EACH STATION

1 doz. negatives of all sizes, including both plates and films, some coming from exposure drill, 1 pkg. dental films, developing racks for plates and films. For each group of six men: 2 pkg. developer, chemicals to make 2 gal. fixing bath. For class use: 16 gal. distilled water.

SEVENTH PERIOD. *Dark Room Procedure. Practice in Developing*

1. Explanation of work by instructor.
2. Student develops first film without any direction from instructor.
3. Negative examined by instructor.
4. Repeat same procedure for rest of the first plates or films.
5. Students develop last six without help.
6. Instructors examine day's work.

MATERIAL AT EACH STATION

1 doz. 4 x 5 films, all conditions of exposure, 1 pint developer, 1 pint hypo or fixing bath, plates from exposure drill.

EIGHTH PERIOD. *Dark Room Procedure*

1. Lecture No. 5: The combined effect of exposure and development on the quality of the negative.
2. Students develop plates simultaneously, the instructor announcing the various amounts of time necessary. The following are developed:
    1. Exposure one-tenth normal, development one-fourth normal.
    2. Exposure one-tenth normal, development normal.
    3. Exposure one-tenth normal, development twice normal.
    4. Exposure normal, development one-fourth normal.
    5. Exposure normal, development normal.
    6. Exposure normal, development twice normal.
    7. Exposure four times normal, development one-fourth normal.
    8. Exposure four times normal, development normal.
    9. Exposure four times normal, development twice normal.
3. Quiz at the end of period on all points brought out.

MATERIAL AT EACH STATION

3 4 x 5 films, exposure one-tenth normal, 3 4 x 5 films, exposure normal, 3 4 x 5 films, exposure four times normal.

NINTH PERIOD. *Dark Room Procedure. Negative Defects and Remedies*

Procedure:

1. Student Officer develops underpenetrated plate.
2. Student Officer develops overpenetrated plate.
3. Student Officer develops fog plate.
4. Student Officer develops plate showing motion.
5. Instructor demonstrates plate taken with emulsion against screen.
6. Instructor demonstrates plate taken with emulsion against glass.
7. Instructor reduces dense plate.
8. Instructor develops double-coated film showing crimp marks.
9. Instructor demonstrates other plate defects as hypo crystals on plate, air bubbles, dirt, grease, finger marks, etc.

MATERIAL:

Underpenetrated plate, overpenetrated plate, fog plate, plate showing motion, plate with emulsion against screen, plate with emulsion against glass, dense negative, reducing solution, plate showing other defects.

TENTH PERIOD. *Dark Room Procedure*

EXAMINATION

1. Students get plates ready for examination.
2. Instructors and assistant instructors examine plates and films developed by each student.
3. Oral quiz and chance to ask questions.
4. All plates turned in.
5. Check material at stations.

A Typical Set of Examination Questions

1. Give the structure and composition of the emulsion used in the *x*-ray plates.

What is meant by ripening the emulsion?

What is the difference in structure between a *duplitized* and a single-coated film?

What is the effect of exposure on the emulsion?

2. Give the formula for the developer used here.

   Give the function of each ingredient and its effect on the plate.

3. Give the formula for the fixing bath used here.

   Give the function of each ingredient and its effect on the plate.

4. How would you judge correct development?

   How long would you fix a plate?

   How long would you wash a plate?

   Give directions for reducing an over-developed plate.

   How could you dry a plate quickly for examination?

5. Draw an outline and label plans for a dark room. Describe plans, briefly.

X-RAY ANATOMY—POSITION DRILL —EXPOSURE DRILL

Instructor: Captain James W. Levering, M. C.; *Assistant Instructors:* Lieut. M. D. Baker, M. C., Lieut. A. O. Truelove, M. C.

Number of Students, 48. Duration of course, 2 weeks, as follows: Daily lecture to entire class, 1 hour. Daily laboratory period to one-half class, 2 hours. Written examination at the end of each week. (Note: In the laboratory the students work in pairs, using each other as patients.)

Apparatus Used: Anatomical charts, *x*-ray plates, blackboard, skeleton, two base hospital (large type) machines and tables with separate tube stands and two field outfits with the tube beneath the table, a large view box and a stereoscope.

First Lecture: Osteology as seen on *x*-ray plates. Types of bone; consideration of surfaces of the bones. Classification of eminences and depressions.

Composition of Bone: $\frac{1}{3}$ organic, $\frac{2}{3}$ inorganic. How alterations of the composition may be seen on the *x*-ray plate.

Structure of Bone: In detail.

Development of Bone: *Briefly*. Illustrate difference between intra-cartilaginous and intra-membranous. Stress laid on fact that cartilage is not converted into but is replaced by bone.

Action of osteoblasts and osteoclasts.

Growth of Bone: Long bone, short bone, flat bones. Discussion of epiphyses, the relation of the nutrient artery to time of ossification of epiphyses. Rules concerning the direction of the nutrient artery.

The Upper Extremity: Shoulder, girdle, scapula—its importance.

Scapula: Demonstration of body, head, neck, spine process, etc. Location of nutrient foramen. Osseous centers. Practical considerations. Clavicle—discussion of abduction. Description of the bone. Difference between the outer and inner articulation. Deltoid tubercle—its resemblance to callus. Nutrient artery. Osseous centers. Practical considerations. Injuries.

Humerus: Description of proximal end. Anatomical neck. Surgical neck. Osseous centers. The conical epiphyseal cartilage, time of union.

The Shoulder Joint: Ligaments, size of joint, the weak point, practical considerations. Displacements. (1) Anatomical factors in favor. (2) Anatomical factors opposed.

Second Lecture. Upper Extremity (cont.); Humerus (cont.): The shaft. Its shape. The rough surface for attachment of deltoid. The musculospiral groove. The location of the nutrient foramen. Anatomical facts to be considered in fracture of the shaft and in cases of non-union.

The Distal End: Description of condyles, articular surfaces, the fossa. The carrying angle. The osseous centers. The lower humeral epiphysis.

The Forearm: Its function. The axis of rotation in pronation and supination The ulna continuous with the humerus

acts mainly as support and serves as an anchoring part for the attachment of the muscles that move the radius which is continuous with the hand.

The Inter-osseous Ligament: Direction of its fibers. How force is thus transmitted from the radius to the ulna.

The Ulna: Description. Proximal end large and cancellous. The two processes and two articular cavities. Tubercles. Action of triceps and brachialis anticus. The shaft. Nutrient foramen. Sharp inter-osseous border. Distal end. Head, styloid, groove for extensor carpi ulnaris. Ossific centers. Practical consideration. Epiphyseal lines, fracture.

FIG. 21. POSITION AND EXPOSURE DRILL ROOM.

The Radius: Description. Proximal end. Head. Neck. Bicipital tubercle. Action of biceps. Shaft: Upper portion compact. Lower portion cancellous; nutrient foramen. Distal end: Description. Osseous centers. Epiphyseal lines. Fractures.

The Elbow Joint: Type, ligaments, the weak points, the shape of the bones, dislocations, disease, the extent of the capsule, osseous centers in and without the joint, time of appearance as well as union. The prominent internal condyle of humerus and the prominent olecranon not in the capsule. Bursa.

The Carpus: Developed from single osseous center with the exception sometimes of the scaphoid. Scaphoid ***bipartem*** peculiarities of the shape and arrangement of the different carpal bones. Time of appearance of ossification.

The Inferior Radio-ulnar Articulation.

The Radio-carpal or Wrist Joint: Emphasis laid on the ridge on the articular surface of the radius, the triangular fibro-cartilage; the attachment of the internal lateral ligament to the styloid of the ulna. The annular ligaments and the tendons. Importance of epiphysis at wrist.

The Metacarpus: Arrangement, description of the shaft, extremities, osseous centers, epiphyseal lines; peculiarity of the first metacarpal. Practical considerations.

The Phalanges: Description, osseous centers, epiphyseal line, sesamoid bones. The Mid-carpal Joint. The phalangeal joints.

Third Lecture. The Lower Extremity: Consideration, designed to bear weight and for locomotion. Pelvic girdle. Innominate (ilium—ischium—pubes) united in acetabulum by cartilage and ossified by sixteen years.

Os Ilium: Description, importance of the crest, the spines, groove for reflected tendon of rectus femoris, articular surface for sacrum and ossific centers.

Ischium: Description, body, groove, the spine, the tuberosity, the bursæ in proximity, ramus, ossific centers.

Pubes: Description, body and rami, ossific centers, description of the acetabulum, ossific centers, practical considerations.

The Femur: Description, proximal end, description of the head location of ligamentum teres. The angles of the neck, the trochanters, digital fossa, etc., Location and direction of the nutrient arteries in the neck, Shenton's line, horizontal lines.

The Hip Joint: Type, ligaments, location and function, extent of the capsule, practical considerations, great security, dislocations, fractures, disease—frequent and grave, anatomical reasons, coxa valga and coxa vara.

The Epiphysis of the upper end of the femur. Time of appearance and of union.

Fourth Lecture. The Femur: The shaft, description. The distal end, description. Markings of the condyles. The plane of articulating surfaces. The osseous centers. The epiphyseal line.

The Patella: Sesamoid in origin. Its function. Description. Development.

The Fibula: Description, external malleolus, ossific centers. Epiphyseal lines.

The Tibia: Description. Nutrient canal. Upper end. Articular surfaces. Bifid spine. Patellar tubercle. Epiphyseal lines. The grooves on the tuberosities. Internal malleolus.

Fig. 22. Localization Room.

The Knee Joint: Type, ligaments and accessories. Bursæ. Location and communications with the joint. Practical considerations: (1) Anatomical factors favoring dislocation. (2) Anatomical factors opposed to dislocation. Relation of capsules to the epiphyseal lines. The chief seats of growth in length of the lower limb. Disease. Loose bodies. Hilton's Law. Genu Valgum and Varum.

The Ankle Joint: Type, ligaments. Capacity of synovial sac. Practical considerations.

The Foot: Intended for support and locomotion. Key to its pathology, a knowledge of the bony structures. The internal and external division of the bones of the foot.

The Tarsal Bones: Description. Peculiarities and practical considerations. Time of appearance of osseous centers. Epiphyseal line of os calcis. The sub-astragaloid joint.

The Metatarsal Bones: Description, development, epiphyseal lines. The phalanges, description, osseous centers, sesamoid bones, practical considerations. Flat foot, injuries.

Fifth Lecture. The Vertebral Column: Consideration, composed of many pieces, united by tough fibro-cartilaginous disks, by which the force of shock is broken and the great range of movement is distributed among many joints. Its fixed points, the curves, the numerous prominences.

A Typical Vertebra: Diagram, body of centrum and the arch (2 pedicles, 2 laminæ, 7 processes.) Consideration, spongy character of the body. Interlocking of articular processes. Position of spinous and transverse processes.

The Cervical Vertebræ: Characteristics. The peculiar cervical vertebræ.

The Dorsal Vertebræ: Characteristics. The peculiar dorsal vertebræ.

The Lumbar Vertebræ: Characteristics. The peculiar fifth lumbar vertebra.

The Sacrum: Description. Osseous centers. Anomalies. The lumbro-sacral and the sacro-iliac joints.

The Coccyx: Description. Practical considerations. The spine as a whole. Fracture, dislocations, diseases and postural changes.

The Ribs: Description. Head, neck, tubercle, angle and groove, the peculiar ribs.

The Sternum: Description. Manubrium, gladiolus, xyphoid, The angle of Lewis, osseous centers.

Sixth Lecture. The Skull: Consideration. The bony framework of the head, enclosing vital structures, supported upon the summit of the vertebral column. Composed of a series of flattened and irregular bones which with one exception are immovably joined together.

The Cranium: Development of the inner and outer tables. The difference in the structure of the two tables. The markings on the inner table. The diploic space. Points of thinness and thickness.

The Frontal Bone: Description. Practical consideration. The frontal sinuses.

The Parietal Bones: Description.

The Occipital Bone: Description.

The Temporal Bones: Description. Practical consideration. The mastoid.

The Sphenoid Bone: Description. Practical consideration. The sella turcica and the sinuses.

The Ethmoid Bone: Description. Practical consideration. The sinuses. The crista galli. Practical considerations of the cranium, the sutures, the meningeal vessels, the venous sinuses, surgical landmarks, glabella, inion, pterion, etc.

The Face: Bones, six pairs and two single bones. Brief description with emphasis on location of the different bones. The boundary of the orbit, the nose, the mouth. The superior maxilla, practical considerations. The maxillary sinus. The teeth. The inferior maxilla: Description. Practical consideration. Dislocation. Fractures.

Seventh Lecture. Intra-thoracic Viscera: The Thorax, description. The piston action of the diaphragm. Changes in shape of the thorax due to the disturbance of this action.

The Diaphragm: Description. Manner of its contraction. The muscular fibers. The regional anatomy. The lymphatic supply.

The Pleuræ: Closed sacs. Serous membrane. Negative pressure. Distribution. Meaning of mediastinal, interlobar, diaphragmatic, pleura. The costo-phrenic angle. The lymphatic supply.

The Trachea: Regional anatomy. Points

of constriction. Level of bifurcation. The main bronchi: Difference between right and left. The bronchial tree. Discussion of the distribution, particularly of the apex. The paravertebral, the 1st and 2d interspace bronchi. The anterior and posterior divisions throughout.

The Lungs: Difference between right and left. The root structures. The course of the main fissures and the accessory fissures on the right. Variations. The lobes. Upper and lower. Anterior and posterior considerations. The lung unit. Lobule. The terminal bronchus. The peribronchial structures. Discussions and diagrams showing course of artery, veins and lymphatics along the bronchus and the distribution at the alveoli and air sacs. Cross section anatomy of the lung structures.

The Heart: Position. The normal curves. The pericardium. The Arch: Regional anatomy. The Thymus: Regional anatomy. The Thyroid: Regional anatomy.

Eighth Lecture. The Alimentary Apparatus:

Consideration: The alimentary canal and certain accessory organs. The canal a musculomembranous tube about 36 ft. in length extending from mouth to anus. Lined throughout by mucous membrane.

The Esophagus, 9 inches long, 1 inch diameter, flattened, gullet relations to adjacent structures. Point of constriction. Diverticulum.

The Stomach: Discuss the differences in position and shape between the stomach seen by *x*-ray examination and that described in anatomies.

Capacity: Size and shape. The importance of the contents and the pressure of surrounding structures. Regional anatomy.

Description: Pars cardiaca, pars media and pars pylorica. The pyloris, description.

The Duodenum: Description, 3 portions. Peculiarities of the 1st portion or cap. Relation to the gall bladder. The 2d and 3d portions. Position of the fixed duodenum. The ligament of Trietz. The ampulla of Vater.

The Jejunum and Ilium: Structures. General distribution. The iliocecal valve. Meckel's diverticulum.

The Large Intestine: Difference in structure and action from those of the small intestine.

The Longitudinal Bands. Haustri Coli. The fixed and the movable points.

Cecum: Appendix, hepatic flexure, splenic flexure, sigmoid.

The Accessory Organs: The teeth, salivary glands, liver, gall-bladder and pancreas.

Ninth Lecture. The Genito-Urinary Tract:

The Kidneys: Location and regional anatomy. Kidney structure. Description of normal kidney pelvis, variations within the normal.

The Ureters: Course. Regional anatomy. Points of constriction. The Bladder. Description.

Tenth Lecture. Anatomical Landmarks as Applied to Localization. The course of the principal arteries, veins, and nerves in the extremities is demonstrated upon the living subject and by means of charts. The boundary of joints is likewise demonstrated.

Charts of cross-section anatomy of the thorax and the abdomen are demonstrated with a view to instruct the student as to the manner of determining the depth of the various organs from the skin landmarks.

OUTLINE OF LABORATORY WORK

1st Laboratory Period: Drill in principles of position and exposure. Adjustment of tube above and below the table.

2d Laboratory Period: Position and exposure drill of upper extremities.

3d Laboratory Period: Criticism of plates taken on previous day and quiz in anatomy of same.

4th Laboratory Period: Position and exposure drill, lower extremity.

5th Laboratory Period: Criticism of plates taken on previous day and quiz in anatomy of same.

6th Laboratory Period: Position and exposure drill in spine.

7th Laboratory Period: Criticism of plates taken on previous day and quiz in anatomy of same.

8th Laboratory Period: Position and exposure drill, head.

9th Laboratory Period: Criticism of plates taken on previous day, and quiz in anatomy of same.

10th Laboratory Period: Visceral positions and quiz in anatomy of visceral plates.

REMARKS

In the laboratory an effort is made to combine truly the subjects in *x*-ray anatomy, exposure and position drill. The laboratory keeps abreast of the lectures.

In the laboratory the students work in pairs, one acting as subject while the other acts as operator.

The standard positions and exposure tables as given in the X-Ray Manual are followed throughout.

The student is made to repeat his plate until a satisfactory one is turned in.

The plates are used not only to criticize faults in position and exposure but as well to demonstrate the anatomy of the various parts.

Weight-bearing lines, parallel joint lines, etc., are marked on the plate.

A TYPICAL ANATOMY EXAMINATION

1. What is the capitellum?
2. Discuss the extent of the capsule of the hip joint upon the neck of the femur.
3. Describe (preferably by diagram) a typical vertebra.
4. What is the direction of the nutrient artery in the clavicle, the femur, the radius and the first metacarpal.
5. (a) What bones comprise the internal set in the foot?
   (b) Indicate the location of the epiphyseal line on the os calcis.
6. What is the time of appearance of the osseous centers at the upper end of the femur.
7. (a) Where should the central ray enter in an A. P. of the shoulder; an A. P. of the hip; an A. P. of the knee; a lateral of the elbow?
   (b) What is the time of exposure at 5″ spark gap, 40 ma. 20″ distance for these regions?
   (c) What direction is the shift for stereoscopic examination of the femur? Of the forearm?

8, 9, 10. On plates A, B, and C name the anatomical structures marked.

LOCALIZATION OF FOREIGN BODIES

Instructor, Captain E. S. Blaine, M. C.

The course of instruction in localization was intensely practical, and, as in other phases of the work, was based on the advice of those in authority at the front. A glance at the schedule of this course will show what methods were taught, all of which have been described, both in the U. S. Army X-Ray Manual and in THE AMERICAN JOURNAL OF ROENTGENOLOGY, so need not be repeated here.

Table drill, the first laboratory step,

SCHEDULE OF PERIODS IN LOCALIZATION COURSE

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1st week	1 Table Drill	2 Fixed Angle Method, Lecture and Practice	3 Fixed Angle Method, Practice	4 Parallax Method, Nearest Point Method, Lecture and Practice	5 Parallax Method, Practice	Examination
2nd week	6 Hirtz Compass Plate Method, Lecture and Practice	7 Hirtz Compass Plate Method, Plotting and Setting Compass	8 Hirtz Compass Screen Method, Plotting and Setting Compass	9 Eye Localization, Lecture and Practice	10 Eye Localization, Plotting and Reporting	Examination

Each period, 2 hours daily, 5 days each week—total of 20 hours.
Classes of 24 students, 4 to each table.

consisted of taking down and reassembling the table, after a very definite and systematic manner, a very important procedure, for the reason that practically all the work with the table had to be done in darkness. The drill made the student familiar with each part and its function in relation to other parts of the apparatus. Each student had to qualify in this drill before going farther in the course. The accompanying photograph shows five of the six complete fluoroscopic outfits of this laboratory. The plate methods were practiced in another operating room.

BONE LESIONS, TRAUMATIC AND PATHOLOGICAL—FRACTURES AND DISLOCATIONS

Instructor: Major Wm. H. Stewart, M. C.; *Assistant Instructor:* Capt. J. J. Clark, M. C.

LECTURE NO. I

General Considerations: Definitions and varieties. Methods of examination. Advantages and disadvantages of the fluoroscopic method. Advantages and disadvantages of the roentgenographic method. Advantages of the combined methods with standardization of technique. Advantages and disadvantages of using the tube above and below. Necessity of immobilization. Importance of examining in more than one position. Value of the stereoscopic method. Importance of numbering roentgenograms and designating which side of the body examined. Consideration of the patient during the examination following the cardinal rule of a minimum amount of disturbance; adjusting the apparatus to the patient rather than the patient to the apparatus. Effect on bone of high and low speed projectiles. Effect of splints. Bone repair in fractures. Importance of fractures involving joint surfaces. Care in interpreting multiple lesions. Recognition of gas infection. Bedside examination.

Proper procedure in conducting a roentgen department in a military hospital. Organization of staff. Attention to details. Encouragement of daily consultations in the roentgen department.

STANDARDIZATION OF REPORTS, ADOPTING THE FOLLOWING FORM:

Roentgenographic examination reveals a	Single or Multiple	Complete Incomplete Comminuted Impacted Fissured Depressed Perforatory Diastatic	Fracture of the	.......side ...... part

The line of fracture is	Irregular Transverse Longitudinal Oblique Spiral "T" shaped Stellate	And extends from a point	......cm. from .... bony landmark	Downward Inward Upward Outward	To about .....cm.

The Fragments are	In good alignment Overlapping to the extent of..............cm. Angulated to the extent of..............cm.

The	Upper Lower	Fragment is displaced	Upward Downward Inward Outward

LECTURE NO. 2

Fractures and Dislocations of the Upper Extremities: Importance of differentiating between the normal epiphyseal lines and those produced by fracture. Common fractures and dislocations of the phalanges, metacarpals and carpals. Importance of recognizing rotation in dislocation of the semilunar. Varieties of Colles fracture. Importance of recognizing a disturbance of the normal relation between the styloids of the radius and ulna and the tilting of the lower fragment backward. The difficulty in proper replacement of the fragments in fractures of both bones of the forearm, and the value of the re-examination after reduction.

Roentgen consideration of the different varieties of fractures and dislocations around the elbow joint. The importance of examination in two positions, even when the forearm is placed in acute flexion. Dangers of musculospiral paralysis and pseudarthrosis in fracture of the middle third of the humerus.

Study of the common fractures and dislocations at the shoulder. The importance of roentgen examination after trauma of the shoulder when clinical signs of fracture are missing, as in fracture of the greater tuberosity of the humerus. Emphasis laid

on the value of the stereoscopic method of examination of the shoulder, including the scapula.

LECTURE NO. 3

Fracture of the Skull: Consideration of the normal skull as a whole. The common sites for fracture. The tendency of fractures to replace themselves. Recognition of the two varieties of fractures, i.e., those in which the bony lesion is of no importance except as a clue to the site of serious lesions of the soft parts as in fissured fracture of the vault, and those where the bony lesion is of importance where fragments of bone produce pressure on the vital structures, such as in depressed or penetrating fractures. Frequency of fracture of the vault involving the base; causes. The different varieties of fracture. The importance of a complete examination with consequent ability to make a positive negative diagnosis. Emphasis paid to the rule of a minimum amount of disturbance of the patient in these cases. Bleeding from the ear, nose or mouth, laceration of the scalp, hematoma or paralysis as a clue to the site of the lesion. Importance of immobilization. Details of the technique used in examination of the frontal, lateral, occipital and basilar regions. The necessity of recognizing the normal suture markings and the lines cast by the meningeal grooves on the inner table, also those cast by the diploëtic spaces between the tables of the skull, with the differentiation between these markings and those cast by fracture. Value of the stereoscopic method of examination of these lesions.

FIG. 23. FIRST VIEW, PLATE READING ROOM.

Fractures of the facial bones and the difficulty of recognition in the roentgenograms. Technique to be used in fractures of the malar bones and the zygomatic arch. The frequency of fracture of the lower maxilla; the common sites. The technique in the proper examination of these lesions, espe-

cially those of the condyle. The extensive comminuted fractures of the jaw from high speed projectiles; the effect usually on the exit side.

LECTURE NO. 4

Fractures and Dislocations of the Spine: The importance of a proper conception of the normal, and the interrelation of the normal bony landmarks in the upper cervicals. The proper technique for examination in injuries to the atlas and axis. The danger of moving the patient in all spine injuries. The frequency of the anterior fracture-dislocation of the cervicals and the importance of obtaining a lateral without turning the patient on his side. How to overcome the difficulties in obtaining proper detail of the seventh cervical. The infrequency of fracture or dislocation of the upper or mid-dorsals. Consideration of the common crushing fractures and lateral fracture-dislocations of the lower dorsals and lumbars. The importance of the stereoscopic examination and the lateral roentgenogram in these lesions. The necessity of obtaining good bony detail in the interpretation of fracture of the transverse processes. The anomalies of the fifth lumbar with recognition of sacralization.

Fracture of the Ribs: Importance of stereoscopic examination. The frequency of emphysema of the soft tissues from a punctured lung by a fragment of fractured rib.

Fracture of the Pelvis: Causation and common sites. Necessity of examining the entire pelvis. Fracture of the acetabulum.

LECTURE NO. 5

Fractures and Dislocations of the Lower Extremities: Consideration of the different varieties of fracture of the neck of the femur and dislocation of the hip and recognition of same. The technique of the stereoscopic method of examination and the value of the oblique roentgenogram of the hip with instructions how properly to obtain same. The necessity of a comparative study of the normal hip.

Fractures of the Shaft of the Femur: The importance of the lateral; the difficulty of replacement and the necessity of a roentgen control after replacement. The value of bedside examination where extension is being used. Obtaining the lateral without disturbing the patient.

Varieties of fracture of the lower third of the femur and dislocations at the knee. Fracture of the patella; rupture of the ligamentum patellæ and fracture of the tubercle of the tibia.

Varieties of fracture of the upper third of the tibia with emphasis on those involving the joint surface. Importance of comparative studies. Fracture of the middle third of the tibia with necessity of examining the entire leg on account of the frequency of fracture of the upper end of the fibula accompanying torsion fracture of the tibia. The difficulty of the surgeon in properly reducing fractures of both bones of the leg and the necessity of roentgen control. Consideration of the common fractures of the tibia and fibula in the lower third. The importance of disturbance to the weight-bearing line, most frequently produced by the outward dislocation of the astragalus accompanying these injuries. The necessity of calling the attention of the surgeon to this dislocation. Consideration of the method of production and varieties of fracture of the tarsals, especially the os calcis and scaphoid. The technique for the examination of the tarsals, metatarsals and phalanges, especially the lateral, and the frequent fractures and dislocations of these bones. Fracture of the sesamoid bones at the distal end of the first metatarsal.

LECTURES ON BONE PATHOLOGY

LECTURE NO. 1

Study of the normal bone structure in long bones as seen roentgenographically with consideration of the component parts, namely, the epiphysis, epiphyseal cartilage, medullary canal, cortex and periosteum,

and the peculiar normal formation in flat bones.

The importance of being able to differentiate roentgenographically between benign and malignant lesions in bone. Necessity of a clear and detailed clinical history in each case. The value of diagnosis by analysis, especially pathology in the long bones. The five cardinal points to be considered in roentgenographic diagnosis by analysis, i.e.,

1. Point of origin
2. Production or destruction
3. Expansion or non-expansion
4. Condition of the cortex
5. Invasion or non-invasion

Illustration of the practical application of this method in the differentiation between benign and malignant growths in the long bones such as bone cysts, Brodie's abscess, and a slow-growing endosteal sarcoma. Roentgenographic changes in lesions of the flat bones. Difficulty of diagnosis after operative interference.

LECTURE NO. 2

General pathological and roentgenographical consideration of bone tumors. Importance of clinical history. Necessity of knowing the age and sex of the patient. Special value of roentgenographic diagnosis by analysis.

Classification with explanation:

- Bone Tumors
  - Benign
    - Cysts
    - Chondroma
      - Enchondroma
      - Perichondroma
    - Osteochondroma
    - Osteoma
  - Malignant
    - Primary sarcoma
      - Endosteal
        - Slow-growing
        - Rapid-growing
      - Periosteal
        - Ossifying
        - Non-ossifying
    - Secondary
      - Sarcoma
      - Carcinoma
        - Osteoclastic
        - Osteoplastic

LECTURE NO. 3

Bone Cysts: Most commonly seen in the long bones; observed most frequently between the ages of seven and fifteen years; occur in adults. Two forms, unilocular and multilocular. Particularly susceptible to fracture; often presence is unsuspected until trauma occurs. Roentgenographic analysis: Point of origin usually in the medullary canal; occasionally in the cortex; there is some destruction from a slow-growing expansion; no production is present unless from repair of fracture through the cyst wall; the cortex is thinned but intact; there is no invasion. The walls of bone cysts are as a rule sharply defined.

Chondroma: Two forms, enchondroma and perichondroma.

Enchondromas are cartilaginous growths which may or may not be cystic. Most commonly seen in the long bones near the epiphyseal cartilage; frequently in the metacarpals. May be multiple. History of a slow-growing tumor. Roentgenographic analysis: Point of origin usually medullary; there is no production unless trauma has occurred; expansion is present; the cortex is thinned but remains *intact.* There is no invasion. Attention to the difficulty of differentiating between a bone cyst and an enchondroma; surgically, however, it is not important as both are benign.

Perichondroma: The true form is most commonly seen involving the phalanges. Consists of a circular-shaped mass of hyaline cartilage with concentric or irregularly shaped deposits of bone at the periphery of the mass. They are periosteal in origin extending outward into the soft parts, often between the toes or fingers. Some production in the growth occurs; the cortex may become thinned and eroded secondarily.

Osteochondroma: Tumor having a history of slow growth, usually cauliform in shape with a broad base or a pedicle of bone and an expanding periphery which consists of a varying amount of cartilage. Most commonly seen at the upper end of the humerus or the lower end of the femur. Arises, as a rule, near the epiphyseal line and is directed away from the joint. Roentgenographically the point of origin is from the cortex. The normal cortical lines extend out into the bony portion of the growth.

There is no invasion. As ossification becomes complete, they become true osteomas.

Osteoma: Numerous varieties. Most common are the completely ossified osteochondroma and the single and multiple exostosis. In the first we have all the characteristics of the osteochondroma with no cartilage present; they are seen most frequently at the ends of the diaphysis near the epiphyseal line; the upper end of the humerus and the lower end of the femur are most commonly involved. They are cortical in origin with a broad base or united to the shaft by a pedicle. The normal bone markings extend out into the bony growth. There is production with no expansion or invasion. The history is of a slow-growing tumor.

Exostoses are single or multiple bony tumors which grow out from the cortex at right angles to the shaft or follow the course of a tendon. The normal bone markings always extend out into the growth. The single form is usually the result of some local irritation such as the spurs on the under surface of the os calcis, anterior surface of the tibia and the inner surface of the femur. Multiple exostoses are congenital, involving all bones, and have a distinct family trait.

Osteomas of the long bones are called cancellous while those of the flat bones, such as the skull, are extremely dense and known as ivory osteomas.

LECTURE NO. 4
Malignant Tumors of Bone

General Considerations: Explanation of classification. The difficulty of differentiating roentgenographically between sarcoma and carcinoma. Importance of clinical history; in this differentiation carcinoma of bone always being secondary and as a rule located near the nutrient artery. Tendencies of all malignancy to destruction and invasion. The three sarcomas showing bone production: osteosarcoma, slow-growing endosteal sarcoma and ossifying periosteal sarcoma. Dependency of the activity of sarcoma on the character of the cell, round-celled sarcoma being most malignant; spindle-celled sarcoma not so active. Frequency of growths showing both cells. Malignancy of bone does ***not*** extend into and involve a joint.

Study of Slow-growing Primary Endosteal Sarcoma (commonly known as giant-celled sarcoma): Two varieties; the non-malignant and the malignant. The non-malignant is known as myeloma, myeloid sarcoma, non-malignant giant-celled tumor, and recently Barrie describes a hemorrhagic osteomyelitis which comes under this class. Roentgenographically, the point of origin is in the medullary canal. They are slow growing, consequently we have expansion with pressure destruction, thinning of the cortex with no invasion; the cortex remains ***intact***. The tumor has a tendency to grow in all directions rather than up or down the shaft. It does not have a sharp line of demarkation as a bone cyst. The ***malignant*** form of giant-celled sarcoma gives a history of slow-growing tumor seen most frequently in the lower ends of the radius, ulna and tibia. Roentgenographically it is central in origin with a slow pressure destruction usually in all directions. There is expansion with a thinning of the cortex which is perforated. The periosteum throws down protective layers of bone as the tumor invades the soft parts, producing what is known as trabeculation. These tumors as a rule contain spindle as well as giant cells. Differentiation from the non-malignant form is based on the perforated cortex, the invasion of the soft parts and the trabeculation; the latter places them in the class of sarcomas where production occurs.

Osteosarcoma comes under the class of slow-growing endosteal sarcomas. They usually arise from the cortex. The point of origin is sometimes difficult to ascertain. There is marked production with some destruction of the shaft, very little, if any expansion. The cortex is destroyed and replaced by the bony growth and there is invasion of the soft parts. Often we have

acts mainly as support and serves as an anchoring part for the attachment of the muscles that move the radius which is continuous with the hand.

The Inter-osseous Ligament: Direction of its fibers. How force is thus transmitted from the radius to the ulna.

The Ulna: Description. Proximal end large and cancellous. The two processes and two articular cavities. Tubercles. Action of triceps and brachialis anticus. The shaft. Nutrient foramen. Sharp inter-osseous border. Distal end. Head, styloid, groove for extensor carpi ulnaris. Ossific centers. Practical consideration. Epiphyseal lines, fracture.

The Radius: Description. Proximal end. Head. Neck. Bicipital tubercle. Action of biceps. Shaft: Upper portion compact. Lower portion cancellous; nutrient foramen. Distal end: Description. Osseous centers. Epiphyseal lines. Fractures.

The Elbow Joint: Type, ligaments, the weak points, the shape of the bones, dislocations, disease, the extent of the capsule, osseous centers in and without the joint, time of appearance as well as union. The prominent internal condyle of humerus and the prominent olecranon not in the capsule. Bursa.

The Carpus: Developed from single osseous center with the exception sometimes of the scaphoid. Scaphoid ***bipartem*** peculiarities of the shape and arrangement of the different carpal bones. Time of appearance of ossification.

The Inferior Radio-ulnar Articulation.

The Radio-carpal or Wrist Joint: Emphasis laid on the ridge on the articular surface of the radius, the triangular fibro-cartilage; the attachment of the internal lateral ligament to the styloid of the ulna. The annular ligaments and the tendons. Importance of epiphysis at wrist.

The Metacarpus: Arrangement, description of the shaft, extremities, osseous centers, epiphyseal lines; peculiarity of the first metacarpal. Practical considerations.

FIG. 21. POSITION AND EXPOSURE DRILL ROOM.

The Phalanges: Description, osseous centers, epiphyseal line, sesamoid bones. The Mid-carpal Joint. The phalangeal joints.

Third Lecture. The Lower Extremity: Consideration, designed to bear weight and for locomotion. Pelvic girdle. Innominate (ilium—ischium—pubes) united in acetabulum by cartilage and ossified by sixteen years.

Os Ilium: Description, importance of the crest, the spines, groove for reflected tendon of rectus femoris, articular surface for sacrum and ossific centers.

There is no expansion. The normal cortex is thinned but present and there is no invasion. The joint surfaces are not involved.

LECTURE NO. 6

Acute Periosteitis: Considered under superficial osteomyelitis.

Chronic Periosteitis: Different varieties. Roentgenographic appearance in the simple inflammatory form. Importance of the differentiation between the simple pyogenic or luetic forms where the periosteal production is laid down parallel to the long axis of the bone, the late syphilitic periosteitis where the productive lines are at right angles to the shaft, the terminal ends uniting, giving a "lace-work" effect, and a periosteal sarcoma where the production is at right angles to the shaft with free ends to the radiating lines, producing a "sunburst" appearance.

Acute Osteomyelitis: Varieties. Endosteal or deep; periosteal or superficial. Emphasis laid on the negative roentgenographic findings in the first two weeks in acute osteomyelitis. Consideration of the causative organisms. Study of the roentgenographic and pathological changes which occur in the acute endosteal form. Importance of clinical history. Diagnosis by analysis. Point of origin medullary; early destruction followed by production. The absence of expansion in this lesion, the process spreading up and down the shaft. The thinning and destruction of the cortex with perforation at numerous points. The stripping up of the periosteum with the formation of sequestra. The perforation of the periosteum and the invasion of the soft parts with sinus formation, and lastly the central production or repair from the remaining portion of the endosteum, and the formation of the involucrum from the undamaged periosteum.

Two Forms of Superficial or Periosteal Osteomyelitis: The first usually the result of trauma causing local destruction with formation of subperiosteal abscesses, and the latter caused by secondary extension from primary infection in the soft parts. Osteomyelitis following compound fracture from projectile wounds with infection; tendency to sequestration and pseudarthrosis. Repair. Consideration of acute osteomyelitis in the flat bones with the tendency to sequestration.

Chronic Osteomyelitis (endosteal form): Most cases of the acute process become chronic from remaining traces of the infection with the repeated formation of sequestra. Brodie's abscess with its chronic history and its characteristic roentgenographic appearance of a bone cavity with sclerosed edges. The superficial form of chronic osteomyelitis with persistent sinuses and localized destruction. Rare forms, tuberculous and syphilitic. Tuberculous very chronic, liable to be multiple; occurs most often in children; other manifestations to aid in diagnosis. Syphilitic osteomyelitis, long standing lesion. Roentgenographically shows extensive changes without corresponding clinical manifestations. History and Wassermann test aid in the differentiation.

LECTURE NO. 7

Syphilis (congenital and acquired): General consideration of the productive tendency of syphilitic infection of bone. Pathological and roentgenographic changes that occur in endosteal and periosteal lesions both in the early and late manifestations, special attention being paid to the simple periosteitis syphilitica in differentiation from the late form. Description of the serrated appearance of the epiphyseal cartilage in the congenital form in children with the causes for these changes. The value of the Wassermann reaction in these lesions. Syphilis of the flat bones with differentiation roentgenographically.

Rickets: Description of the pathological and roentgenographic changes which occur in this disease, special attention being paid to the hemorrhagic changes in the epiphyseal cartilage and the softened flaring ends of the diaphysis as well as the bowing of the long bones and their tendency to fracture.

Scurvy: Study of the pathological changes that occur in the epiphyseal cartilage. The early dislocation of the epiphysis with soft part thickening and the formation of the white line at the epiphyseal cartilage; the second stage manifesting itself by subperiosteal hemorrhages; the third stage by absorption and ossification of these hematomas with the resultant bone deformities. Roentgenographic appearance in each stage.

Ossifying Hematoma (hemorrhage beneath the periosteum) is seen most frequently following trauma, also in scurvy. *Early* roentgenographic findings, except in scurvy are rather unsatisfactory. In about three weeks the periosteum begins to lay down new bone and the blood clot undergoes organization with deposition of calcium salts. The bony deposit is always in striæ parallel to the long axis of the bone; this is important in the differentiation from malignancy where the striæ are perpendicular to the shaft.

Myositis Ossificans (ossification in the muscles): History of trauma in the local cases. Roentgenographically it is seen following the lines of the muscle fibers, having no connection with the periosteum. There is a general form, constitutional in character. Etiology uncertain. The muscles progressively undergo calcareous degeneration.

Osteitis fibrosa cystica is a rare condition characterized roentgenographically by a softening of the bone, bowing with cylindrical expansion of the shaft, and formation of multiple cysts. The cortex is as a rule intact unless fractured. Seen most frequently in young adults and observed more often in the upper end of the femur than in any other of the long bones.

Osteitis Deformans (commonly known as Paget's disease): Sometimes this condition is mistaken for the resultant of osteomyelitis. It is seen in the long bones and skull. The long bones are enlarged and bowed; the normal bone markings are lost and replaced by longitudinal areas of absorption intermingled with striæ of longitudinal increased bony formation; the cortex as a rule is thickened. The condition may be local; it is almost always a general condition with accompanying changes in the skull which becomes enlarged and shows irregular thickened areas of bony deposits. As a rule there is an accompanying calcareous arterial degeneration.

LECTURE NO. 8

Arthritis: Importance of a knowledge of the roentgenographic appearance of the normal joint with a study of the soft parts, articulating cartilages, the synovial membrane and the synovial fluid. General consideration with classification:

$$\text{Arthritis}\begin{cases}\text{Acute}\\ \\ \\ \text{Chronic}\end{cases}\begin{cases}\text{Polyarticular rheumatism}\\ \text{Traumatic Synovitis}\\ \text{Infectious}\begin{cases}\text{Pyogenic}\\ \text{Pneumococcic}\\ \text{Gonorrheal}\\ \text{Tuberculous}\\ \text{Syphilitic}\\ \text{Unknown origin}\end{cases}\\ \text{Hypertrophic}\\ \text{Atrophic}\end{cases}$$

Acute Polyarticular Rheumatism: Roentgenographic findings indefinite. Soft part swelling; increase in synovial fluid; no destruction of the cartilages. Value of the comparative study of the interarticular space. After subsidence of inflammation return of joint to normal.

Acute Traumatic Synovitis: Roentgenographic findings; swelling of the soft parts; increase of synovial fluid as shown by increase of interarticular space; no cartilaginous destruction. Importance of study of normal in comparison. Need of roentgenograms showing soft part detail. History of trauma. Tendency to recur. Resultant: Normal joint.

Pyogenic and Pneumococcic Arthritis: Roentgenographic consideration: First stage, periarticular swelling; increase in synovial fluid; no cartilaginous changes. Second stage, decrease in periarticular swelling; decrease in synovial fluid; erosion of cartilages with some destruction of bone beneath and at the same time some bony production at the edges of the articulations. The characteristic point in this form of in-

fectious arthritis is the destruction and repair going on at the same time. There is some atrophy of bone from disuse. Third stage, subsidence of the periarticular swelling; disappearance of the increase of synovial fluid; cessation of destruction; increase in production with partial or complete ankylosis, depending upon the severity of the infection and the amount of the joint involved; disappearance of atrophy.

Gonorrheal Arthritis: Roentgenographic findings depend upon the severity of the lesion. As a rule, we have the same three stages as in the pyogenic form. The process has a tendency to more extensive destruction of the articulating cartilages and the bone beneath. There is seldom any evidence of repair in the second stage and we are more liable to have firm bony ankylosis in the stage of repair.

LECTURE NO. 9

Tuberculous Arthritis: In adults the primary focus is usually in the epiphysis with extension into the joint. In children we see a distinct synovial form. Roentgenographically in the first stage we have extensive periarticular swelling, often before the bony defect is detected; this gives us the characteristic fuzzy appearance of the roentgenogram. Importance of comparative studies of the normal. There is an early tendency to bony atrophy. The synovial fluid is increased. The different stages are lengthy when compared with the pyogenic and gonorrheal form of arthritis. The second stage is characterized by destruction of the articulating cartilages and the bone beneath; this destruction may cover a period of years; the synovial membrane may be destroyed with invasion of the soft parts surrounding the joint and formation of sinuses; when this has occurred there is liability to a mixed infection, which is shown by bony production. When we have a straight tuberculous infection without sinus infection, production does not occur until the late third stage when we see subsidence of the inflammation with the formation of fibrous or bony ankylosis, partial or complete. The complete sequence of events may cover a period of years.

Syphilitic Arthritis: The simple form shows extensive periarticular swelling, fuzziness to the roentgenogram from thickening of the synovial membrane, and increase in the synovial fluid; no cartilaginous destruction or subsidence or inflammation. The joint is restored to normal. History and Wassermann test aids in diagnosis. Serration of the epiphyseal cartilage often accompanies these joint changes; more frequently some periosteitis is detected at the junction of the epiphyseal cartilage and the end of the diaphysis. Often a "punched out" appearance at this point is observed; when detected it is sufficient for diagnosis.

Charcot Joint (neuropathic): Not infectious. Indirectly due to syphilis. Characterized roentgenographically by great increase in size of joint; increase in synovial fluid; destruction of the articulating cartilages; eburnation of the ends of bones and formation of varying amount of detritus within the joint. There is no bony atrophy. The clinical picture of a loose, wabbling painless joint, with considerable function, is an aid in diagnosis.

Infectious Arthritis due to Unknown Causes: Usually presents the roentgenographic picture of a pyogenic arthritis.

Hemophilia may occur in a joint giving changes similar to tuberculosis. The clinical history will aid in clearing the diagnosis.

LECTURE NO. 10

Atrophic Arthritis: Disease of middle age. There is marked atrophy of the soft parts and the bones; partial subluxation may occur; there is destruction of the cartilages with *no* production. There is no increase in the synovial fluid.

Hypertrophic Arthritis: Common joint disease of middle and old age. Roentgenographically there is no atrophy, rather an increase in the bone density. Articulating cartilages are thinned or destroyed with productive lipping at the edges. This production may form knot-like bony formations which may break off and lie loose

in the joint, commonly known as "joint mice." In the late stage we may have flattening of the articulating ends of the bone with some eburnation. The production may be so extensive as to bridge from one bone to the other causing ankylosis. Trauma may "light up" an old hypertrophic arthritis with marked increase in the loss of function.

REMARKS

All of the lectures were fully illustrated by lantern slides showing typical lesions. In addition all students in sections were given as near as possible individual instruction for two weeks in the interpretation of roentgenograms showing the subjects lectured upon. They were required to examine and report fully on each case. Instructors then went over the interpretation with each student, correcting the errors as shown by the report, and upon this daily showing, combined with the results of a weekly examination, the student was rated.

TYPICAL EXAMINATION

1. What are the advantages and disadvantages of fluoroscopic examination in bone lesions?
2. What are the advantages and disadvantages of the plate method of examination in bone lesions?
3. Describe the technique used in the correct roentgenographic examination of the occipital region.
4. What are common injuries to the ankle joint? What is the important factor in these injuries?
5. What are the most common injuries to the carpals? Describe fractures.
6. What is the capitellum? Name the common injuries to the elbow.
7. What is the cardinal rule to follow in the examination of skull and spine cases? Describe the proper method for the lateral examination of the cervical spine.
8. How would you detect a fracture of the neck of femur and how would you ascertain whether impaction is present?
9. Why is the prognosis in fractures of the middle third of humerus especially bad?

SYNOPSIS OF LECTURES ON THE CHEST

Lecturer: Lieut. Col. W. F. Manges, M.C.

LECTURE NO. 1

Brief review of anatomy and technique of examination.

Types of chests, usually true to general physique of patient. (Illustration of extremes, and mean, including consideration of all thoracic contents and diaphragm.)

Trachea, position, bifurcation, displacement important sign. Main bronchi and their divisions into trunks, distribution. Subdivisions seen only in plates of sharp detail, and then not to the surface of the lung in the normal.

Location of fissures, deviations from the normal, supernumerary or partial lobes not uncommon.

Hilum area, normal a matter of judgment, and based on observation of many apparently healthy individuals. Calcified or otherwise dense glands found as result of dust collections, previous acute infectious diseases, or tuberculous infection in childhood. Contributive evidence only.

Technique of Examination: Fluoroscopic and plate methods, advantages of each.

LECTURE NO. 2

Pulmonary Tuberculosis

Peribronchial: Localized peribronchial thickening, never general or widespread. Most frequent in distribution of vertebral and first interspace trunks. Exudate not marked as a rule when cases are seen, but may be sufficient to obscure detail of tubercle shadows. Small tubercle shadows give bronchi beaded appearance, and bronchial divisions may be traced from the hilum to the surface. Tubercles usually small. Tends to progress into parenchymal

type, but may heal without involving parenchyma. Patients seldom sent for examination, or roentgenologists do not recognize it. Diagnosis difficult, following acute bronchitis, bronchopneumonia, or influenza. Differential diagnosis depends on location, persistence of thickening, and beaded appearance of bronchi.

Parenchymal Tuberculosis: May be extension from peribronchial type, or apparently start in parenchyma. First appears in upper lobes, usually above or in second interspace. In exudative stage shadows of more or less distinctly localized consolidations appear. They may be filmy in character and are near the surface as a rule. Patients not sent for *x*-ray examination as a rule in this stage. Following exudative stage, lesions become more sharply circumscribed, due to formation of fibrous tissue; and shadows of organized tubercles, conglomerate, caseous, or calcareous, appear. The linear markings become more distinct and straighten out, extending from periphery to hilum. In short, the lesion passes from acute to chronic fibroid or fibrocaseous. May remain localized and heal, becoming chronic inactive, or heal at one place and progress downward in another, becoming chronic active tuberculosis, in which case it always becomes bilateral and again starts in the upper portions of the lobes of the other lung and progresses from above downward.

Involvement of costophrenic area of lung is rare, even in advanced cases, though pleural involvement is common in this region. Abscesses or bronchiectatic cavities, common in upper chest, uncommon in lower lobes. On re-examination at intervals nodular shadows and linear fibrosis more sharp in outline, but do not disappear. Patient may be acutely ill with small area of lesion, or on the other hand may have extensive involvement with comparatively slight clinical manifestations. The roentgenogram is no indication as to virulence of lesion, and frequently fails to determine question of activity, except by repeated examination.

Acute miliary tuberculosis, seldom seen in *x*-ray laboratory, entire lung area dense, contrasty plates impossible, tubercles give lung granular appearance.

LECTURE NO. 3

Bronchitis and Bronchopneumonia.— As a result of repeated attacks of bronchitis root and bronchial shadows become exaggerated. They are not nodular and do not tend to straighten out. Differentiated from infiltrating process of syphilis only by other tests, or in presence of other contributory evidence such as history of primary lesion, dilatation of aorta, etc. Condition common also in asthmatics. General peribronchial thickening is seen after long exposure to dust.

The findings in bronchopneumonia depend upon time of examination. When patients are seen early in course, and rayed repeatedly, areas of consolidation appear from time to time and progress from root to surface, most frequent in lower lobes or mid-portion of lung; one area may be receding while another progresses. Consolidations may be small or large, abscess or interlobar empyema may occur but not as common as in lobar pneumonia. Root and trunk shadows remain heavy for weeks or months, but usually resume normal appearance in uncomplicated cases. Lesion may be more or less nodular and when involving upper lobes may be mistaken for tuberculosis, but these nodules disappear gradually. Condition has not been studied extensively by *x*-ray, except in late stages, or in delayed convalescence. Single plates at bedside usually satisfactory for study of progress. Consolidations may or may not reach surface of lung, and can be detected on plates sometimes days before physical signs appear. Differential diagnosis depends upon more or less rapid change of shadows from day to day, and variety of location, as well as size of consolidations. Prognosis unfavorable when consolidations are numerous, large, and slow to disappear.

LECTURE NO. 4

Lobar Pneumonia: Involvement of one or more lobes, more frequent in lower lobes. In early stage general increase in density, no heavy detail seen. Consolidation rapid, and when complete nearly all detail obscured and remains so until resolution takes place. Consolidation does not progress from hilum to surface, is same throughout lobe. Diaphragm shadow indistinct when lower lobes are involved, but not completely obliterated in uncomplicated cases.

In absence of complications, lobe density disappears rapidly after crisis, but heavy detail remains and leaves only gradually. Certain amount of fibrosis is apt to take place. Complications of pleura, such as effusion, empyema, or adhesions are common, and these together with delayed resolution or abscess formations, which are not infrequent, furnish the usual excuse for roentgenographic study. Conditions of pleura are treated further on. Abscess formation may be mistaken for central consolidation or even interlobar empyema. Repeated examination shows gradual sharpening of outline as abscess wall becomes more organized; tends to discharge through bronchus; and as the center undergoes liquefaction and the cavities contain more or less air, fluid levels can be seen if patients are rayed either in the upright position or while lying on unaffected side. Cavities may be large, small, single, or multiple, more common in lower half of chest. Inflammatory thickening of abscess wall gradually disappears and only slight fibrosis may remain. Dilatation of bronchi occurs occasionally.

Delayed resolution is recognized by prolongation of lobe density, and heavy peribronchial shadows. When an upper lobe only is involved condition is difficult to differentiate from tuberculosis except by repeated examinations. General density and peribronchial shadows disappear gradually, whereas they do not in tuberculosis, and any interstitial thickening that may remain after pneumonia does not have the nodular appearance seen in tuberculosis. Pneumonia in any stage or complication involving only the lower lobes is never looked upon as being tuberculosis. Almost daily bedside examination is practical and should be of value.

Cavities (Abscess and Bronchiectatic): Abscess cavities in tuberculosis are common in upper lobes, not large as a rule, single or multiple, resulting from breaking down of large conglomerate tubercles, and discharging through bronchi. They become infected with pyogenic organisms as well. Abscess walls may be thick or thin, depending on amount of fibrosis, but usually irregular.

Early, wall not sharply outlined nor of definite shape, inner surface not smooth, but becomes more so with age, and finally cannot be differentiated from bronchiectatic cavity. Seldom seen to contain more than small amount of pus. Uncommon in lower lobes.

The abscess due to pyogenic organisms following or complicating pneumonia is more apt to be single, may occur in any portion of lung but more frequent in lower lobes. Walls are usually thick, dense, and more or less irregular in outline. Pus level demonstrable, as a rule, unless inflammatory areola closes in and obliterates cavity. Ulceration into bronchus may provide free drainage, in which case healing is rather rapid as a rule, and fairly complete, so that evidence of cavity may disappear. It is very difficult to differentiate from localized interlobar empyema. Fluid level is best point, aside from location. Remaining fibrosis does not resemble that of tuberculosis. Diagnosis should not be concluded on single examination unless fluid level is demonstrated. Fluoroscopic examination very valuable. Abscesses following inhalation of foreign bodies, single or multiple, tend to increase unless foreign body is removed; fluid level seldom seen. Persistent abscess in lower lobes always suggestion of foreign body.

Bronchiectasis is recognizable in two

forms: 1. The more or less cylindrical-shaped dilatation of the larger bronchi. 2. More or less spherical-shaped dilation of smaller bronchi. First type easily overlooked and require plates of fine detail; recognized by shadows of bronchial walls. May involve only one or multiple bronchi. Not apt to be more than two or three times diameter of normal bronchi. Second type, characterized by thin wall, although surrounding fibrosis may be excessive, smooth lining, variation in size from very small to very large, holding as much as a pint at times; variation in number from single to large numbers. Caused by contraction of tissue undergoing fibrosis, or possibly by excessive strain of cough. They do not tend to decrease in size, and in the lower lobes usually contain considerable exudate. Clinical symptoms and signs very important, frequently positive, and should complete differential diagnosis.

LECTURE NO. 5

Tumors of the Lungs. Cysts, usually single, apt to be large, round, very dense, and smooth surface.

Benign Tumors, rare except glandular enlargement in root area or mediastinum, e.g., Hodgkin's disease, substernal thyroid. Position, size, shape, and clinical findings complete diagnosis.

Syphilis of the Lung may appear as mass (gumma) usually at mediastinal border, of variable size and more or less irregular outline. Or as diffuse infiltration along bronchi. In latter type infiltration involves most bronchi, but does not extend to surface. Either type apt to be associated with dilatation of aorta. Positive history or Wassermann test may be necessary to complete diagnosis, as the condition resembles carcinoma, or interstitial changes from other causes. Re-examination after appropriate treatment shows diminution of shadows.

Carcinoma of the Lungs: Primary type rare, infiltrating in character. Metastatic, common, two types, infiltrating and miliary. Infiltrating type may present mass in hilus with peribronchial infiltration or distinct mass may be absent. Pleural involvement with effusion is common in this type. History of primary growth secures diagnosis. Miliary type is characterized by multiple nodules widely distributed, usually small, rather sharply outlined and quite dense, but not really smooth-surfaced.

Sarcoma is only metastatic in the lungs. Sarcoma of chest wall may project into lung area, and is differentiated from encysted empyema by evidence of destruction in portions of one or more ribs. Metastatic lesions usually multiple, vary in size from smallest recognizable to masses of great size, relatively lacking in density, are encapsulated, therefore very smooth on surface and round. History of primary lesions not necessary for diagnosis, appearance on plates is characteristic.

LECTURE NO. 6

Lesions of the Pleura. Serofibrinous: Acute pleuritis with or without pneumonia. No signs on screen or plate until fluid or fibrin appear. Fluid or fibrin or both present in varying quantity. First seen at costophrenic angle, no sharp level present. Upper border oblique from above, downward, and inward, and changes slightly with posture of patient. Visceral and parietal pleura not thickened materially or adherent early, but organization may take place in fibrin as well as adhesions form between parietal and visceral layers, when effusion becomes encysted, but apt to become purulent by time this stage is reached. Sharp outline of fluid strongly indicates empyema. Diaphragm shadow is obliterated when exudate is present in quantity. Only general estimate of quantity can be made. Consolidated lower lobe with small amount of fluid difficult to differentiate from larger amount of fluid alone; only reliable sign is displacement of heart, which is always present with large amount of fluid, and much less so with consolidation of lung and but little fluid. Consolidation of lung alone does not completely obliterate diaphragm shadow. Re-

peated observations determine increase or decrease of fluid.

Adhesive Pleuritis presents signs on the screen or roentgenogram when pleura becomes definitely thickened or adhesions to diaphragm occur. Associated with but little exudate, may be end result of serofibrinous type. Costophrenic angle frequently obliterated.

Purulent Pleuritis is usually a complication or sequel of pneumonia, or penetrating wound. One-half of chest cavity may be completely filled with pus, but lesion is usually more or less encapsulated by adhesions (encysted or encapsulated empyema). May be found in any location where two pleural surfaces are in contact. Axillary border common location, also interlobar area. More frequent along mediastinal border than is ordinarily considered the case. May develop from serofibrinous type or in hemathorax, but most frequently pyogenic from the start. Shadows are very dense, sharply outlined in encysted type. Pleura becomes greatly thickened. Interlobar or mediastinal type may discharge by rupturing into bronchus. Empyema in contact with chest wall demands drainage, and site of this is best determined by the stereoscopic plates as well as viewing from all angles by means of fluorescent screen. Pleura tends to become greatly thickened and then cavity remains after drainage. In chronic empyema after drainage, roentgenograms of good quality reveal thickness of pleura, extent of drainage, and size of cavity. Cavities or sinuses are studied to advantage after injection of bismuth subcarbonate or oxychloride in sterile olive oil. Heavy pastes should not be used. Surgical procedure is based almost entirely on roentgenographic findings. Patients should be rayed in different positions and especially stereoscopically when injected. Bronchial fistula is not uncommon, readily diagnosed by means of injection.

LECTURE NO. 7
Pneumothorax

Spontaneous type due to tear in visceral pleura through traction on adhesion, or by ulceration, may be partial or complete. Border of lung usually seen on plate, also adhesions holding parts of lung to chest wall. Diagnosis depends on absence of lung detail, or detail of compressed lung, and displacement of the heart and mediastinal structures. Prognosis is good in uncomplicated cases. Tuberculous foci frequently found in opposite lung. Condition may be complicated by hemorrhage and become hemopneumothorax, or by infection and become pyopneumothorax. Serous effusion may also occur. When cavity contains fluid of any kind, a sharp fluid level can be seen, and this changes with change of posture of patient. Percussion of the chest wall causes wave motion which is clearly seen on fluorescent screen. Occasionally the character of fluid may be determined by character of the waves. Repeated examination reveals progress of the condition. Penetrating wounds of chest frequent cause, *x*-ray findings same as above described, and in addition fractured rib or foreign body may be seen on the plates.

LECTURE NO. 8
Heart and Aorta

Heart.—Fluoroscopic study important because of constant motion of heart. Character of pulsation at times is more important than size of heart. Bedside fluoroscopy is practicable, especially when pericardial effusion is to be differentiated.

Plate study is of value, especially when there is a focus point—plate distance of six feet. A carefully centered single exposure usually affords about as much information as stereoscopic plates.

The size, shape and position of the normal heart shadow vary with the size, shape and type of individual; e.g., the heart of the robust, deep-chested, hard-muscled man is found to be more or less transverse, for the reason that the diaphragm is high, whereas in the slender, flabby individual, with ptosis of abdominal organs, the heart is more nearly vertical, and therefore presents a smaller transverse diameter. In this

respect, one finds wide variation in the normal. When doubt exists as to whether the heart is of normal size, recourse should be had to one of the heart measurement tables (see U. S. Army *X*-Ray Manual). The right border presents two curves in the normal, that of the right ventricle and the right auricular appendage, and the vena cava, or at times the ascending aorta. The left side presents three curves, the aortic arch, the left auricle, and the ventricle; occasionally a fourth is seen, the pulmonary artery.

Enlargement of heart shadow is due either to hypertrophy, dilatation or effusion in the pericardium. It is displaced by pressure, as in the case of total empyema or pneumothorax, or by traction, as in adhesive plueropericarditis, or contraction of one lung. Occasionally one sees the heart reversed as to sides—transposition, and abdominal organs are also transposed.

Enlargement of hypertrophy is due to excessive physical exertion, to valvular lesions, or obstruction in other parts of circulatory organs, e.g., chronic interstitial nephritis. On fluoroscopic examination, such a heart will show deep, strong, but not as a rule a very rapid pulsation. The aorta, too, will show relative increase in size, except in aortic stenosis or mitral regurgitation.

The transverse diameter becomes more nearly horizontal, and the angles or curves are more acute. Lesions of the mitral valve are accompanied by relative increase in size of left auricle. Breathing is apt to be normal.

Dilatation, either following or occurring independently of hypertrophy, gives the heart shadow more the shape of a pear; the aortic shadow may be normal, and pulsations are feeble, fluttering, shallow, irregular, and usually rapid. Pulsations may be relatively more noticeable in auricular outline than in ventricular. Breathing is apt to be shallow and rapid. Lungs have much the appearance of general peribronchial thickening. This is due to engorgement of blood vessels, and is usually more noticeable in the right lung.

Pericarditis with effusion may give much the same shaped shadow as dilatation, especially when fluid is relatively small in quantity. When pericardial sac becomes distended, the shadow becomes more nearly round, and less nearly pear-shaped. Fluoroscope gives best results, as pulsations become faint and wave-like.

In chronic adhesive pericarditis, heart is displaced; diaphragm fixed to pericardium causes limited motion in diaphragm.

Aorta: Change in size and shape of thoracic aorta may be due to general dilatation and elongation, sometimes called tortuous aorta. Common in late life. Or change may be due to localized dilatation and is then known as aneurysm. Any part may be the site of lesion, or the entire thoracic aorta may be involved. First portion of descending arch is most frequent site. Aneurysms usually project laterally, but occasionally only posteriorly, when lateral or oblique view is necessary to demonstrate their presence. Fluoroscope necessary to differentiate from mediastinal tumor at times, and is a study of pulsation. Plates of fine quality, especially in detail, will occasionally show shadow of atheromatous deposit in wall of aneurysm.

These lectures on the chest were illustrated by carefully selected lantern slides, demonstrating all the points to which attention was called.

SYNPOSIS OF LECTURES ON SINUSES, MASTOIDS, AND TEETH

Lecturer: Lieut. Col. W. F. Manges, M.C.

Sinuses: The first lecture was devoted to demonstration and discussion of the wide anatomical variations, and the technique of exposure, with special reference to care necessary to avoid damage by overexposure or repeated exposure.

The second lecture dealt with lesions of the frontal sinuses, and ethmoid cells. In the third lecture, the lesions of the sphe-

noid sinuses and maxillary antra were considered, as well as combinations of involvement.

The fourth dealt with anatomy and types of mastoids and the technique of examination.

The fifth lecture was on the pathology and complications of mastoids. Special attention was paid to the relation between the lateral sinus and the auditory meatus, and also the postoperative examination, to determine whether any cells remained undrained.

In the sixth lecture, the anatomy and physiology of the teeth and adjacent structures, also the technique of exposure and adjustment of film as well as plate examinations, were considered.

The seventh lecture covered dental and jaw-bone pathology.

There was at all times an abundance of clinical material, both sinuses and mastoids as well as teeth, so that in addition to the lectures and lantern slide demonstrations, the student officers received further practical instruction in the radiographic and interpretation rooms on the subjects.

An additional lecture on brain tumors was given to each class as nearly as possible. This subject was not looked upon as being important from a military point of view, but our collection of lantern slides illustrating many proven cases of various types of tumors afforded most valuable and interesting material for the general subject of interpretation.

LECTURES ON URINARY AND GASTROINTESTINAL TRACTS

The lectures on the urinary tract and the gastrointestinal tract were given by Capt. Myron B. Palmer until he was called to the Surgeon General's Office for duty, and then by Capt. E. S. Blaine. These subjects were approached from a very practical view-point, and only the more common organic lesions were shown. It was, however, considered wise to teach the technique of examination fairly thoroughly with the idea in mind that there would be work of this kind to do in base hospitals, and during the reconstruction period. Then, too, we encouraged the hospital staff to send such patients to us, for they added to our radiographic and fluoroscopic material.

SYNOPSIS OF LECTURES

GIVEN BY LIEUT. CHARLES A. WATERS, M. C., U. S. A.*

LECTURE NO. 1

The Roentgenological Situation in the American Army at the Beginning of the War

Organization of the earliest separate schools for instruction in roentgenology.

First expedition to France, June, 1917.

Tours of inspection to British and French hospitals, including the base and advanced hospitals, especially the mobile formations near the front.

Lessons learned: That surgery must be done in as short a time as possible following the injury, three to five hours. That wherever surgery is done, *x*-ray work is done also. That a small portable type of *x*-ray apparatus capable of generating its own power is necessary. The character of *x*-ray work done in the different types of hospitals, mobile, evacuation and base hospitals. The large number of roentgenologists necessary to care for the sick and wounded. That trained enlisted personnel familiar with the care and handling of *x*-ray apparatus and capable of doing photography is necessary.

LECTURE NO. 2.

The X-Ray Department and the Roentgenologist

Current conditions; Supplies; Difficulties met with in the localization of foreign bodies.

Relationship between the *x*-ray department and the other departments of the hospital. Personal conferences between roentgenologist and the chief surgeon and

* This series of Lectures has not been published.

his staff, organization of department. Roentgenology is a subdivision of surgery. That we wish, above all things, to help and assist the other departments of the hospital in effecting the most efficient methods in the diagnosis and treatment of war conditions.

Cooperation at all times of the day or night in a spirit which will win admiration for the roentgenologist and his staff. Things which attract attention: Politeness and assistance by the enlisted personnel in the department towards the other departments in the hospital. Turning out always the best quality of work. Keeping in very close and intimate touch with everything pertaining to the *x*-ray department. Establishing a precedent that you are there to serve and not to dictate.

Arrival of wounded soldier. Under bad, disagreeable conditions, cold winter nights. Get fire started immediately so that patient will have a warm *x*-ray room to be examined in. Kindness and consideration shown the wounded soldier is greatly appreciated. Have cigarettes handy for them. Fear of a big surgical operation and anesthetic staring them in the face.

LECTURE NO. 3
The Roentgenologist Overseas

Arrival of roentgenologists attached to organized Units; opportunity for observation work with older Units.

Arrival of casual roentgenologist; assignment to staff of Senior Consultant in Roentgenology, A. E. F.; periods of instruction in localization of foreign bodies; reassignment to units at the front or rear.

Esprit de Corps; a great honor to work up front. If you fail to make good at the front you are sent to a unit in the S. O. S. (Service of Supply).

Hospitals in France; base hospitals, advance base hospital 30–50 miles behind the lines. Base hospital areas which relieve the advance base hospital. Rear base hospitals. Ports of debarkation.

Evacuation hospital 5–10 miles behind the lines.

Field Hospitals, Divisional Units. *X*-ray and surgical personnel and apparatus, supplied by headquarters, medical and surgical consultants, A. E. F.; what happens to the apparatus and personnel of a Field hospital when a division goes into repose.

Mobile Hospitals; power, *x*-ray and sterilizer supplied by motor camions; mobile surgical units; units belonging to the headquarters of medical or surgical consultants.

The Triage or Receiving Ward; wounded arrive on stretchers mostly; cloth is cut away; valuables are checked; head and pubic hairs are shaved; patient is deloused; is given bath, a bath-robe and pajamas; then is sent to the preoperative ward.

The Preoperative Ward; old dressings put on in regimental dressing station are replaced with fresh, small, sterile ones; record and description of the wound or wounds are made; shock beds; transportation to the *x*-ray room.

LECTURE NO. 4
Systematic Methods of Examination. Records

Importance of the *x*-ray department to care for the work during rush periods. Preparation of the *x*-ray department during quiet times to meet conditions during the pushes; dividing the staff and enlisted personnel into teams; dividing the working time into eight-hour periods; amount of work one *x*-ray team is capable of doing in eight hours; records; importance of following a routine form for the description of the *x*-ray findings; time saving; importance; cite example.

Methods employed in the localization of foreign bodies; the nearest point; the triangulation method of Strohl; the parallax; the Hirtz compass; Intermittent control.

A brief description of the vital points in the proper execution of these methods.

Skin marking. Difficulties to overcome (pus, blood, dirt, washing with soap, water, alcohol, ether, iodine). Different materials employed; good and bad points of each; Finzi ink; pyrogallic acid and silver nitrate; indelible pencil; skin pencils; small knife

cuts; tattooing. Advantages and disadvantages of each.

LECTURE NO. 5

The x-ray examination of the more uncommon war injuries and diseases; especially those of the head, thorax, abdomen, pelvis and larynx.

Compound fractures and fractures into the joints caused by through and through wounds.

Importance of rotating the patient from side to side in determining whether a foreign body is within a closed cavity or not.

Importance of giving to the surgeon all anatomical landmarks in close relationship to the foreign body.

The diaphragm: Its rôle in foreign bodies which have entered the lung, pleura or abdomen.

Dangers associated with the extraction of foreign bodies from the larynx and neck with the aid of the intermittent control.

The Belot method of fluoroscopic localization of foreign bodies in the eye.

THE MANIPULATOR'S SCHOOL

MACHINE COURSE

Instructor, Lieut. E. H. Herzer, S. C.; *Assistant Instructors*, 2d Lieut. L. S. Uphoff, S. C., 2d Lieut, W. W. Mowry, S. C.

The instruction to manipulators was limited to the theory, operation, maintenance, and repair of the various types of apparatus. During the last few months only a small percentage of enlisted men were brought in contact with the large so-called "Base Hospital" machines. These were the men who, by reason of previous experience or education, were especially fitted for such instruction. Their course in the handling and caring for the portable types and induction coil outfits and especially in the Delco engine was very thorough.

Their instruction in position and exposure drill was limited, and given in such a way that it served more to fasten in their minds the knowledge they had gained in the machine and developing work than to make real operators of them. Anatomical terms, other than those familiar to any schoolboy, were not used, and only the more common positions were practiced.

In every respect it was our aim to make their course as practical and mechanical as possible.

The instructors in the Manipulator's School were Sanitary Corps officers or graduates of former classes. We were constantly increasing the teaching facilities as well as enlarging the entire school, so that there was a constant demand for prac-

MANIPULATOR'S SCHOOL

SCHEDULE

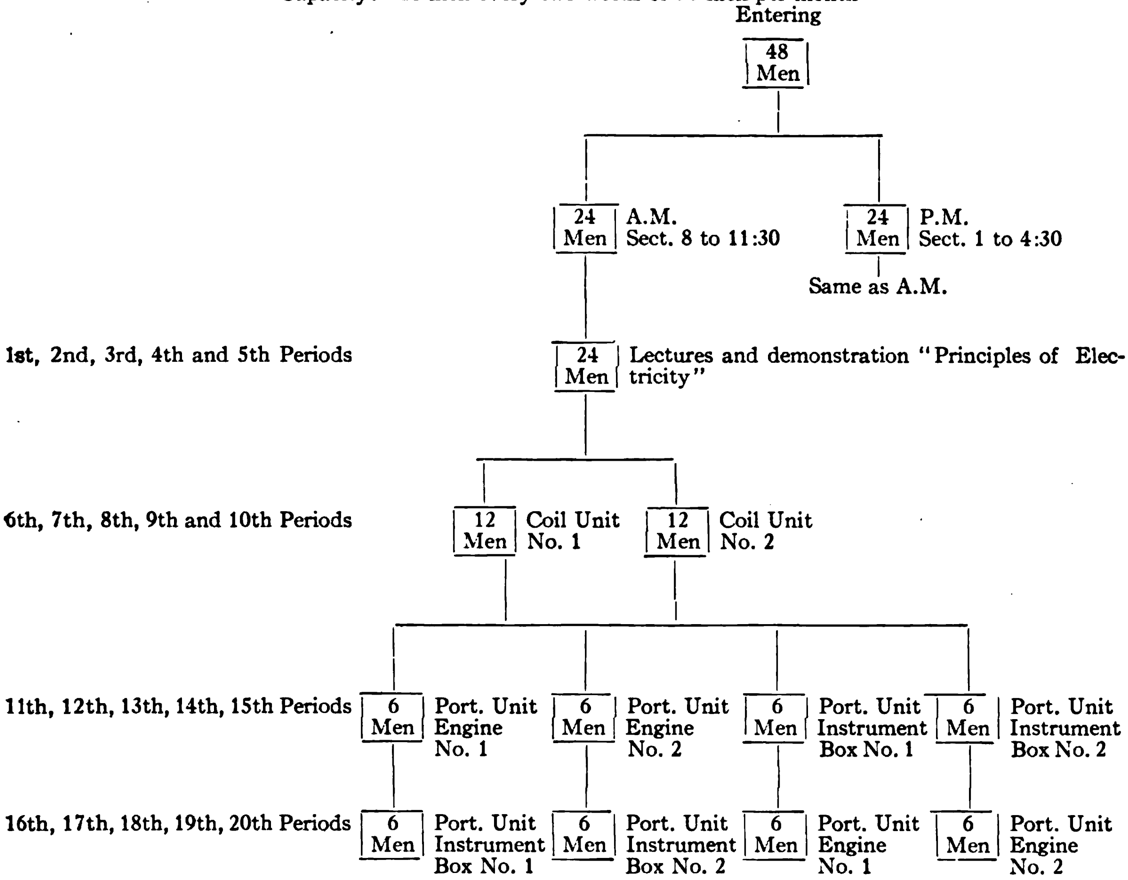
	Machine Course, Electricity and Coil Units		Machine Course, Portable Units		Developing and Dark Room		Position and Exposure Drill	
	8:00–11:30 A.M.	1:00–4:30 P.M.	8:00–11:30 A.M.	1:00–4:30 P.M.	8:00–11:30 A.M.	1:00–4:30 P.M.	8:00–11:30 A.M.	1:00–4:30 P.M.
1st week........	A	B			B	A		
2nd week.......	B	A			A	B		
3rd week.......			A	B			B	A
4th week.......			B	A			A	B
Sec. A—24 men. Sec. B—24 men.								

tical work in the way of wiring, both low and high tension; assembling and adjusting

course were so arranged as not to conflict with the officers.

MACHINE COURSE

Capacity: 48 men every two weeks or 96 men per month



apparatus, and installing the various machines. The manipulators under the direction of their instructors made all the changes in building "T," even to building the developing counters and to mounting the extra large step-down transformer.

In short, it was our purpose to train them to be useful and practical assistants to medical officers, and keep them just as far from actual professional duties as possible.

The assignments of these men in the developing course were similar to those of the officers. Their hours in the machine

In conclusion, we would like to make it clearly understood that the lecture notes as published here are not to be looked upon as original articles. In the main, they follow the teachings of the U. S. Army X-Ray Manual, but they also represent substantially the outline of instruction given prior to the publication of the second edition of the Manual. The teaching material, such as plates, lantern slides, charts, etc., were collected from various sources, but for the most part came from the laboratories of the individual instructors, or were prepared at the school.

MOBILE ROENTGEN RAY APPARATUS*

BY COL. ARTHUR C. CHRISTIE, M. C., U. S. A.

WASHINGTON, D.C.

THE necessity for the employment of mobile roentgen ray apparatus in time of war has been recognized from the earliest days of the roentgen ray. Small transportable outfits were probably first used on an extensive scale during the Boer War. At that early time the outfits were necessarily very limited in their output, since even stationary apparatus was not highly developed. In all important wars since that time roentgen ray work has been done with mobile apparatus supplying its own current. The most usual type has been a coil and interrupter actuated by current from storage batteries, or from a dynamo run by a gas engine. Sometimes a small gas electric set was carried to recharge the storage batteries, and sometimes a dynamo was operated directly from the motor of the automobile in which the outfit was transported.

The World War was of such magnitude, both in respect to the total number of casualties and to the number occurring over short spaces of time in individual engagements, as greatly to increase the necessity for mobile roentgen ray apparatus. Such apparatus has been used by the French, English and Italian armies not only in order to give roentgen ray service to temporary hospitals where no current is available, but to furnish one or more additional roentgen ray plants to forward hospitals during times of great stress.

Both the French and English have depended entirely upon coil and interrupter to furnish the high tension current. The interrupter is usually of the gas-mercury type. Valve tubes are invariably used, and the roentgen ray tubes are the ordinary gas tubes. The use of Coolidge tubes is still quite limited in Europe, and so far as I have been able to learn they have never been used there with portable apparatus, except that furnished by our own Medical Department.

The primary current supply for this apparatus has been furnished in one of two ways: either from a gas-electric set, with or without storage batteries, or from a dynamo operated by the engine of the automobile in which the apparatus is transported. Fig. 1 shows the official

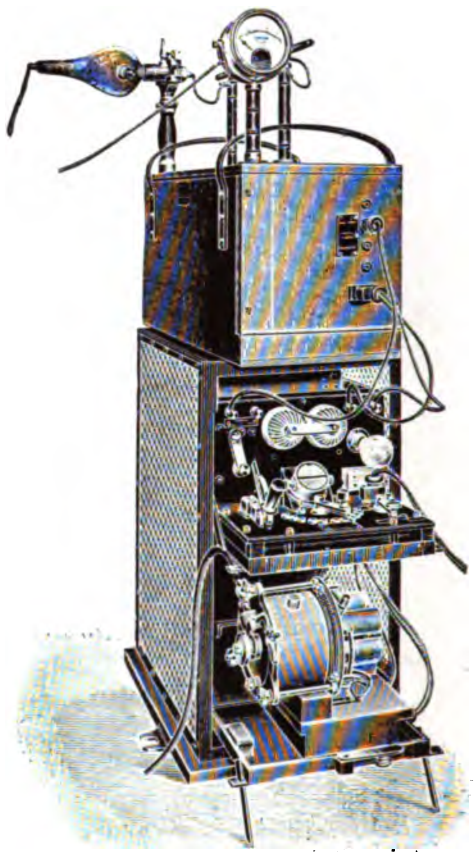


FIG. 1. ENGLISH PORTABLE APPARATUS OF 1915. COIL. INTERRUPTER AND CONTROL TABLE ASSEMBLED.

English type of portable apparatus of 1915 which receives its current supply from the gas-electric set shown in Fig. 2. This is a water cooled gas engine with direct connected dynamo delivering a current of 10 amperes at 60 volts when run at its normal speed. Storage batteries are a part of the apparatus, and by connecting them in

* Authority to publish granted by the Board of Publication, Surgeon General's Office, Washington, D. C.

series with the dynamo a current of 10 amperes at 100 volts may be obtained. This combination makes it possible to obtain 4 or 5 milliamperes through a tube of medium hardness.

Fig. 3 shows the latest type of English apparatus set up ready for operation. The canopy extension connected to the automobile serves as a fluoroscopic room. The body is thoroughly equipped as a dark room. The power for the roentgen ray apparatus and electric lights is supplied by dynamo operated by the motor of the truck.

The French service has also depended upon the coil and interrupter actuating a gas tube, and for generating apparatus has used a dynamo driven by the automobile engine, or in some cases a separate gas-electric set. The output of such apparatus is about 10 milliamperes through a medium tube. Fig. 4 represents the French *Equipage Radiologique* with the mercury interrupter on a shelf by the driver's seat and a gas-electric generating set mounted behind the driver's seat. The latest type of French roentgen ray automobile outfit has been described as follows by Lt. Col. P. M. Hickey:

"It consists essentially of an ordinary automobile with a large box body, which is equipped to serve as a dark room and for storage of tables, etc. The essentially new part of the outfit (Fig. 5) is that the chassis in its forward part is of a peculiar construction. Instead of terminating directly under the forward part of the hood, the front end of the chassis is elongated with a U-like projection of very heavy material. This U-shaped projection serves for the mounting of the dynamo. This dynamo is mounted on a prolongation of the axis of the crank shaft of the motor.

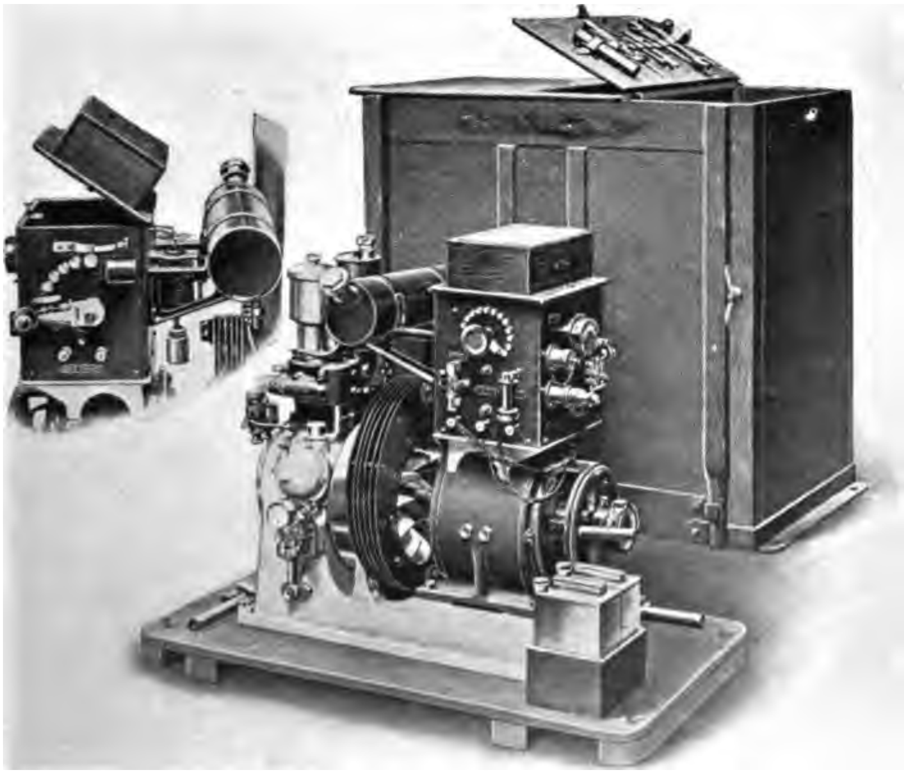


FIG. 2. GAS ELECTRIC SET OF ENGLISH PORTABLE APPARATUS.

The dynamo is rated at 4½ K.W. There is a second low hood which covers the dynamo without disturbing the hood which covers the engine proper. The engine is a 4 cylinder machine rated at 25 H.P. The dynamo is designed to furnish current for lighting the mobile hospital unit and also to operate the roentgen ray apparatus. The interior of the body is quite spacious, the forward part being devoted to dark room equipment. On the left side are racks for drying, in the center is a commodious sink, and on the right a large washing box. On either side of the rear entrance are large well fitting cupboards with double locks containing places for chemicals and various accessories. The roentgen ray tubes and valve tubes are carried in specially designed boxes which can be placed on each side of the body. There is a demountable aluminum top table which folds up and occupies very little space. There is also carried the regular French military demountable table for fluoroscopic localization. There is abundant room within the body for one of the portable Ledoux-Lebard outfits consisting of a coil and mercury interrupter. There is also room for the tube carrier which goes under the operating table." (The table, tube carrier, and other accessories are shown in Fig. 6.)

When the United States entered the war the only type of portable roentgen ray apparatus in use by our army was one consisting of a very heavy gas engine operating a dynamo, the latter having a disc on its shaft to revolve in contact with brushes connected to the terminals of a high tension transformer. This apparatus was cumbersome and its output small.

It was necessary to decide whether the portable apparatus to be adopted by our medical department should be complete in itself with a separate gas-electric generating set, or whether we should depend upon the motor of the automobile for power. A number of reasons, based upon reports of American military observers, influenced the Surgeon General's Office to adopt a portable outfit having a separate gas-electric set. It was observed that automobile engines, not being constructed for this kind of service, got out of order very frequently, not only interfering with

FIG. 3. LATEST TYPE OF ENGLISH ROENTGEN RAY CAMION.

the operation of the dynamo for roentgen ray work, but resulting in frequent delays on the road due to motor trouble. After a heavily loaded truck has been driven a considerable distance, possibly over difficult roads, time must be given to overhauling the motor if it is to be kept in good working order, and of course this cannot be done if the motor is run continuously to operate roentgen ray apparatus after arriving at its destination. Another consideration is that accident to the motor on the road results in disabling the entire roentgen ray outfit, since it depends upon the automobile motor for its power.

The portable apparatus adopted by the medical department is that developed by Dr. W. D. Coolidge. It derives its great advantage over other portable apparatus from the use of a special radiator type of Coolidge tube which rectifies its own current. It permits us not only to use a high tension transformer instead of the coil with the troublesome interrupter, but also eliminates the synchronous motor and revolving devices for rectifying the current. Fig. 7 shows the apparatus without the gas engine, set up in connection with the portable table. Actual practical work under the difficult conditions of war has demonstrated that this is an entirely satisfactory portable outfit. It is true that the maximum output is only 10 milliamperes, but the very fine focus of the new radiator tube makes it possible to do perfectly satisfactory roentgenography of all parts of the body. I will give no detailed description of the apparatus here since it has already been described by Dr. Coolidge, and description of its construction and operation will be found in the U. S. Army X-Ray Manual.

FIG. 4. EARLIER TYPE OF FRENCH ROENTGEN RAY CAMION.

After this apparatus was decided upon it was necessary to determine the type of vehicle in which it was to be transported,

the method of packing, and what accessories were to be furnished. It seemed very desirable to choose, if possible, some standard medical department vehicle instead of devising an entirely new outfit. An automobile which was already standardized could be much more readily secured in sufficient number, and the problem of spare parts and repairs would be greatly simplified. The standard U. S. Army automobile ambulance seemed suited to our purpose and it was found after some experimentation that it could easily be modified so as to carry safely and conveniently the entire roentgen ray outfit with all necessary accessories. This modification was carried out under the direction of Lt. Col. George C. Johnston, M. C., U. S. A.

The standard army ambulance is mounted on a three-quarter ton chassis. It was modified in the following manner to transport the portable roentgen ray apparatus:

The seating arrangements of the standard body are removed, and also the devices for supporting the army litters. Across the front of the body, immediately behind the driver's seat, tying the sides together, is a platform of 2″ plank upon which is securely bolted the Delco gas-electric set with its switchboard, etc., complete. (Fig. 8.) This plank mounting acts as a spring support for the engine and reduces the vibration to a minimum. Packed in the interior of the body are the parts of the portable roentgen ray table, the roentgen ray tube box with its shutters, a portable dark room, an army bedside unit to serve as a spare roentgen ray apparatus, a carrying case for the radiator tubes, the box containing the high tension and Coolidge tube transformers and all the other electrical parts of the portable apparatus, and a box of the standard localizing apparatus. The chemicals, trays, films and other dark room accessories are contained in the portable dark room mentioned above. There is also provided a light-tight canopy with a

FIG. 5. LATEST TYPE OF FRENCH ROENTGEN RAY CAMION, SHOWING MOUNTING OF DYNAMO IN FRONT OF ENGINE.

gaspipe frame for its support which can be erected within any building at hand, or, if necessary, in the open, to serve as a fluoroscopic room. All of this apparatus rides safely in the modified ambulance and does not overload it. On the sides of the body are carried three wood bakelite tops for the portable table. The side curtains of the ambulance are longer than usual and are provided with end flies. The supports for the table tops are hinged and may be dropped down to the horizontal. The side curtain having been drawn over the table tops and the end flaps fastened beneath them, there is provided an excellent pair of tent covered cots upon which

FIG. 6. FRENCH PORTABLE APPARATUS.

FIG. 7. AMERICAN PORTABLE APPARATUS WITHOUT ENGINE.

the chauffeur and technician may sleep. (Figs. 9, 10.) The officer in charge can sleep on the third table top placed on top of the apparatus inside the ambulance.

This outfit was adopted by the Surgeon General's Office after a 2,000 mile road test. It was found practicable to do the entire work of one of our large cantonment hospitals with it when the hospital's apparatus was out of order. The roentgen ray apparatus itself has been thoroughly tested both in this country and in France.

Unfortunately, our modified ambulances did not reach France in time to be placed in operation until after the beginning of the armistice. They have been very thoroughly tested, however, in the Army of Occupation by Lt. Col. E. A. Merritt, M. C., U. S. A., who had charge of roentgen ray work with that army. Lt. Col. Merritt's previous experience in charge of roentgen ray work with the First Army during the time of its active operations renders his judgment on this matter of particular value. His report states that the modified ambulance is entirely satisfactory as a means of transporting the roentgen ray apparatus, with the exception of a few minor changes. The rear tires must be heavier than those on the standard ambulance, and the rear springs must have one extra leaf. All these camions sent to the Army of Occupation were provided with an extra Delco engine to be used for lighting purposes, and with wiring and bulbs for thirty-five lights. It was found by experience that field and mobile hospitals practically always depend upon the roentgen

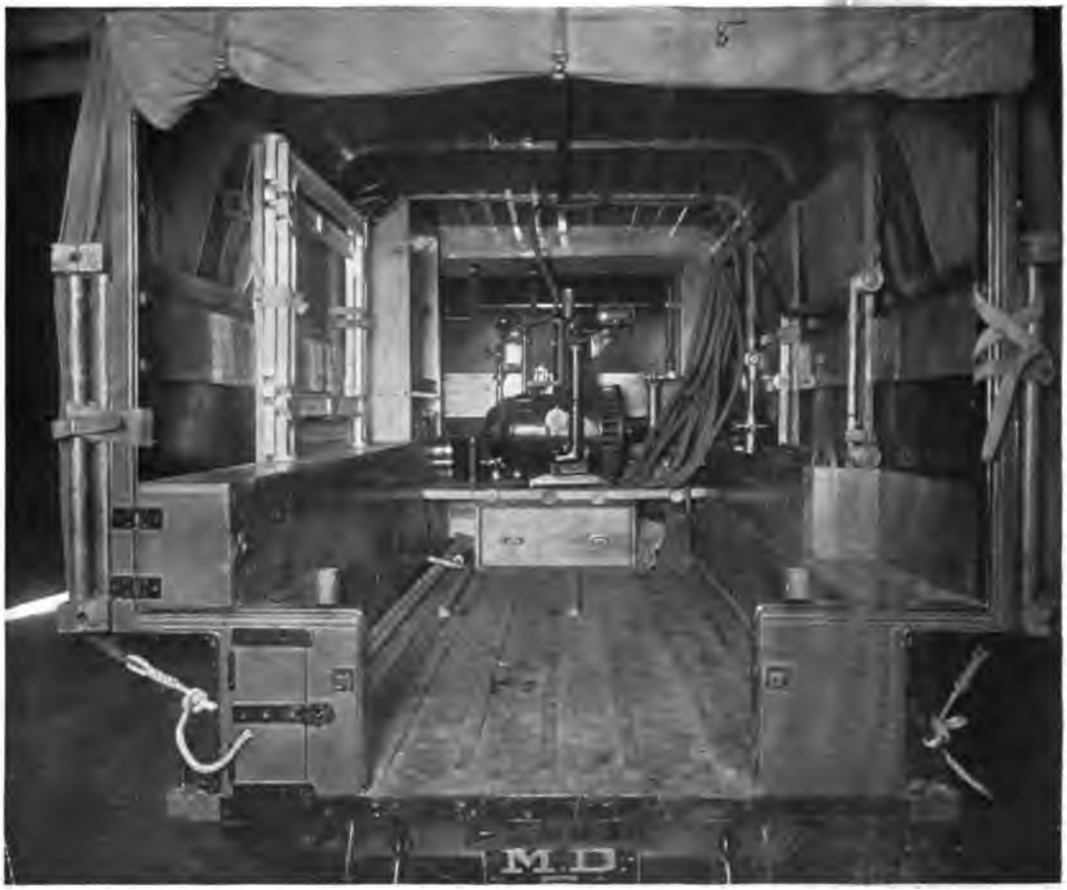


FIG. 8. AMERICAN CAMION WITH ENGINE MOUNTED BEHIND DRIVER'S SEAT.

ray department to furnish lights. Even evacuation hospitals depend upon the engineer department to furnish the necessary

Fig. 9. American Camion with Table Top Arranged for Sleeping.

Fig. 10. American Camion Ready for the Road.

lighting outfits, and in numerous cases the roentgen ray generating outfit has been used for the first twenty-four or forty-eight hours to provide current for lights until the engineering department is able to install a plant. In the French and English camions the lights are supplied with current from the same dynamo that furnishes power for the roentgen ray machine. Experience

showed that this was not satisfactory. There was often great variation in the current to the roentgen ray tube depending upon the number of lights in use, and at times there was lack of penetration due to overloading the line. These objections are eliminated by the use of an extra engine for lighting purposes alone.

FIGS. 11 AND 12. ENGLISH, FRENCH AND AMERICAN CAMIONS, IN ORDER LEFT TO RIGHT.

Because of the late arrival of our own camions in France, it was necessary for Lt. Col. Case, Senior Consultant in Roentgenology with the American Expeditionary Forces, to equip our mobile hospitals with the French camions described above. Most of these were equipped with the standard French apparatus, but a few of them were furnished with the American portable outfits. Excellent work on many thousands of cases was done with the French apparatus. The mercury interrupter, however, was a source of great annoyance, and the use of gas and valve tubes is of course much less satisfactory than the Coolidge tube.

Comparison of the English, French and American camions may be made by reference to Figs. 11 and 12. It will be seen that the American type is much smaller than either of the others. Fully equipped, it weighs about half as much as the French and about a third as much as the English.

The advantage of the English and French camions over the American is that the two former have the body of the car arranged for a dark room, while the latter has not. Experience in this war has shown that the greater part of the roentgen ray work in all hospitals in the forward areas, including evacuation hospitals, is fluoroscopic. An elaborate dark room is therefor unnecessary. The few plates that will be made can be conveniently developed in the small portable dark room furnished with the American apparatus.

The advantages of the American type of apparatus which are now apparent are as follows:

1. The automobile engine is not used to generate power for roentgen rays or lights, and can therefore be overhauled and placed in order between trips.

2. It is much lighter than the English and French types, and has a powerful engine rendering it very mobile. It is doubtful if the heavy types of camions could be operated to advantage over roads less good than those in France.

3. It is essentially the United States Army Ambulance, for which extra parts are carried in stock by the Army.

4. The apparatus is demountable, and can be placed in another camion or even in a truck and taken to its destination, if the original camion gets out of order.

5. The roentgen ray apparatus carried in this camion is not of special type but is the standard Army Portable Outfit.

6. Experiment has shown that the roentgen ray efficiency of the American portable apparatus is approximately eight times that of apparatus depending upon a coil and interrupter and gas and valve tubes.

It is believed that the American portable apparatus carried in the modified ambulance described above, with a few minor modifications tending to simplify it, is the most satisfactory mobile roentgen ray outfit yet devised.

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SIR JAMES MACKENZIE DAVIDSON, M.B., C. M.

THE JOURNAL regrets to announce the death on April 2d, at the age of sixty-two, from heart failure, of one of the world's foremost roentgenologists, Sir James Mackenzie Davidson. His death, which took from the field of roentgen ray diagnostics and therapy one of the pioneers in this department of medical science, is a world's loss which comes home to THE AMERICAN JOURNAL OF ROENTGENOLOGY; for we are deprived of the help of one who has for several years acted as the British representative on our staff of collaborators, and who has been one of the few honorary members of THE AMERICAN ROENTGEN RAY SOCIETY.

Before the advent of the roentgen ray, Mackenzie Davidson was an ophthalmic surgeon. Naturally when the roentgen ray was added to the medical armamentarium, Sir James gave his first thoughts to its adaptation to the diseases and particularly to surgery of the eye. In 1897, he and Hadley published articles on the triangulation method of foreign body localization, visualizing in space the position of the foreign body by means of crossed threads. The same year, Mackenzie Davidson successfully produced stereofluoroscopy for the first time. This achievement laid the foundation for the train of experimental work, closely followed up by Caldwell of New York, which culminated in the production by Caldwell of a practical stereofluoroscope, described in these columns a few months ago. As early as July, 1897, Davidson published a roentgenogram of a bladder stone, and foresaw the usefulness of the roentgen ray in the diagnosis of renal calculi.

James Mackenzie Davidson's father was an early settler in Brazil, and the son was born there and received his early education in the Scottish school of Buenos Aires. He studied medicine in Edinburgh, London, and Aberdeen, graduating at the latter university in 1882 with the degrees of M. B., C. M. His early practice took him at once into the specialty of eye surgery, which claimed the major interest in his life for the next two decades. In 1886 he became ophthalmic surgeon to the Aberdeen Royal Infirmary and to the Royal Hospital for Sick Children, which positions he held until 1895. All this time he was lecturer in ophthalmology in the

University of Aberdeen, where his inborn qualities as an instructor attracted large numbers to his classes. Not a few of his students have since distinguished themselves in ophthalmic work.

His friends bear witness to his unfailing cordiality, his keen personal interest in all who took their problems to him, and his kindness and courtesy to his patients.

SIR JAMES MACKENZIE DAVIDSON

Mackenzie Davidson's natural bent toward physics gave him early a familiarity with the experimental and practical phases of electricity and light (and, by the way, of this store of knowledge he gave freely toward the education of the public by popular lectures, lavishly illustrated by costly experiments). Naturally, Davidson was prompt in recognizing the importance of Roentgen's discovery and its import to the future of medicine and surgery. He at once set about the production of the roentgen rays, and was probably the first in Scotland to produce and utilize the new rays. He continued his investigations in Aberdeen until in 1897 he removed to London, where he continued his work until his death.

His interest in physics and a natural genius for invention led him all his life to continue his efforts to improve old and devise new roentgen ray apparatus. His invention of the stereofluoroscope has already been referred to, as well as his "cross-thread localizer." Davidson was so thoroughly impressed with the value of the stereoscopic method that he not only taught it but consistently practiced it in practically all his examinations.

In 1890, he described a new form of rotary mercury interrupter, which came into general use as the Mackenzie Davidson "break." One of his latest inventions was a roentgen ray couch (described last year in the pages of this JOURNAL) especially designed for war work and permitting very rapid localization of foreign bodies.

A further accomplishment of our distinguished friend was the development of a telephone attachment for use in localizing foreign bodies. This was a telephonic attachment to forceps which could be opened to include the foreign body as well as to act as a probe. This and his cross-thread localizer were tested out in the South African war, as well as during the European war just closing.

In addition to his interest in the roentgen rays, Davidson was one of the earliest workers with radium, and he was one of the first to suggest the value of radium-therapy in certain forms of roentgen ray dermatitis.

In 1916, Davidson became honorary consulting roentgenologist to the military hospitals of the London districts, though he regretted keenly his inability to take a commission and go out to France.

In 1912–13, he was president of the Roentgen Society of London, and of the Radiology Section of the International Congress of Medicine in London in 1913. At the time of his death, he was consulting surgeon of the *X*-ray Department of the Royal London Ophthalmic Hospital, Moorfields, and of Charing Cross Hospital.

Dr. Thurstan Holland, a close friend of the deceased, writes: "My feeling about the value of his work and the originality of many of his inventions is that the work was done at a time when so little was known about *x*-ray apparatus, when even the means of energizing an *x*-ray tube was primitive, and when the difficulties were so very great. He showed the way to many of us. He was a man who always welcomed anyone interested in *x*-ray work, and he was always ready and willing to show his methods and demonstrate his intruments to his fellow workers."

Those of us Americans who have enjoyed the privilege of friendship with this talented pioneer heartily endorse the foregoing tribute, and take this opportunity of offering to Lady Davidson and other members of the family the sympathy of American roentgen ray workers.

James T. Case.

X-Ray Training of Manipulators by U. S. Army

Young men entering the army are offered opportunity to become X-ray manipulators, as will be seen by the following:

The U. S. Army is offering to men enlisting for a three-year term many educational advantages. Young men possessing preliminary education may enlist in the Medical Corps with a view to training as X-ray manipulators. They will be given a three months' course at the Army Medical School, Washington, D. C. The course of instruction will cover Electro-physics, construction and operation of all types of X-ray apparatus, including the U. S. Army X-ray Ambulance, the Bedside X-ray unit, the portable field type of apparatus, dark room work, photography, electrical wiring, installation, care and repair of X-ray and electrical apparatus, gas engine construction, care and repair, etc.

Application for this enlisting should be made to the Surgeon-General, U. S. Army, Washington, D. C., attention of the Chief, Section of Roentgenology.

David R Bowen M.D.

THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, H. M. Imboden, M.D., New York.

VOL. VI (NEW SERIES) AUGUST, 1919 No. 8

THE INJECTION OF AIR FOR THE ROENTGEN DIAGNOSIS OF TUMORS OF THE BLADDER*

BY GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PA.

THIS method is not new and has probably been used by a number of men. I have spoken of it at meetings occasionally during the past ten years and have been using it in my practice for at least twelve years, but it seems to me a method that is not used sufficiently, and for this reason I am again calling attention to it in the form of a more or less definite paper.

The examination of the bladder for tumors by the expert cystoscopist has been so successful that this modified roentgen method has probably not been developed to the fullest advantage; but there are many cases in which an examination by the cystoscopist is not practical for one of the following reasons:

(1) Because of the severe pain which generally accompanies these examinations;

(2) Because of the inability to pass the cystoscope;

(3) Because of severe hemorrhage;

(4) Because of decided objection on the part of the patient;

(5) Because an expert cystoscopist is not always at hand.

Therefore, when one can obtain definite information with regard to tumors of the bladder, especially as to size, position and conformation, such evidence should not be neglected. Even when a cystoscopic examination can be made, I believe that the information obtained in this way will be of additional advantage.

Technique.—It is my custom to make an anterior plate and a posterior one before attempting an injection of air. This demonstrates the condition present independent of the air injection. In this way one is able to localize the air or gases which may be retained in the rectum or pelvic colon. One may also recognize the presence of a stone in the bladder. The urethral orifice is then cleansed in the usual manner necessary for catheterization. The catheter is chosen according to conditions present, utilizing the largest size that will pass without pain or inconvenience. An atomizer bulb is then attached to a piece of glass tubing so adjusted that it can easily be attached to the catheter. This glass tubing and the catheter should be sterilized. An extra precaution against the injection of germs from the air into the bladder consists in utilizing a glass tubing which is wide at one end, into which can be inserted a plug of sterile

* Read before the Philadelphia Roentgen Society, May 8, 1919.

cotton; this will filter the air to a certain extent during the injection. I believe that the danger of injecting germs from the air is not serious, for ordinarily they would not be likely to find a suitable culture medium and would probably be dealt with by the bladder without harm. Besides this these cases are usually infected before they come for a roentgen ray study and commonly the patient is passing pus and blood rather freely. However, there are times when every possible precaution must be observed.

The catheter is passed into the bladder. Generally one finds considerable residual urine. This is removed, the bladder is compressed until one has eliminated so far as possible all of the fluid in the bladder. Air is then injected or compressed into the bladder by means of the atomizer bulb until the patient complains of distress, distention or desire to urinate and generally one can outline the bladder by percussion. If the injection is made slowly and due attention is paid to the complaints of the patient, I believe that no harm can be done. It is possible, of course, to overdistend the bladder or even to rupture a diseased bladder by this process.

When the bladder is fully distended, a pair of hemostatic forceps are clamped over the catheter, the atomizer bulb is removed and one or more plates are made posteriorly; the patient is turned on the abdomen and one or more plates are made anteriorly, directing the rays through the bladder obliquely from below upward so as to avoid the pubic arch as much as possible. Generally the anterior view will give most information, but it is decidedly an advantage to utilize both positions. I have never found it necessary to strap the catheter in place, and it has never come out during my examinations. Care of course must be observed, for one can displace the catheter easily when rolling the patient over. If it is accidentally removed, it must be reinserted, for the retention of the air in the bladder will probably give the patient considerable distress. As soon as the examination is finished, the patient is turned upon the back, the clasp removed from the catheter, and all of the air allowed to pass out. Generally it is advisable to compress the bladder by pressure in the suprapubic region, which will assist in the expulsion of all of the air.

Up to the present time I have never had any disadvantage or serious objection to this examination either on the part of the patient or as evidenced by any bad after results.

New Growths.—I have succeeded in demonstrating new growths in the bladder as small as a thimble; in other cases half of the bladder area has been involved. At times the tumor has been located directly over the prostatic area, in others on the lateral wall of the bladder, and in others apparently above the prostate, on the posterior wall. One can of course never decide positively whether these new growths are malignant or benign, neither can they be decided positively by the cystoscope; one judges by size, position and general outline. If the tumor is large, occurs in an older patient, and is irregular in outline, especially if it presents a broad base, one would think first of malignancy. If it is small, smooth and pedunculated, one would think first of a benign growth. But whether the growth is benign or malignant, the only chance a patient has for recovery consists in its removal, by electro-coagulation through the cystoscope, by electro-coagulation through a cystostomy, by excision or thermocautery, or by means of the direct application of radium. In any of the above surgical methods of treatment, excepting that of radium, the growth can be examined microscopically after its removal. Since there is a tendency of all benign growths to become malignant later, it is surely advisable to treat them as malignant in their earliest stages, leaving nothing undone that would be of value in the destruction or elimination of the growth if it were known to be malignant.

Enlarged Prostate.—The enlarged prostate can usually be palpated, and such an examination as I have described is not always necessary, but even in these cases it is often an advantage. By palpation through the rectum one can often determine the size and outline of the prostate, but it is a distinct advantage in some instances to know the appearances of the upper or anterior surface of this tumor. If smooth and regular in outline the first

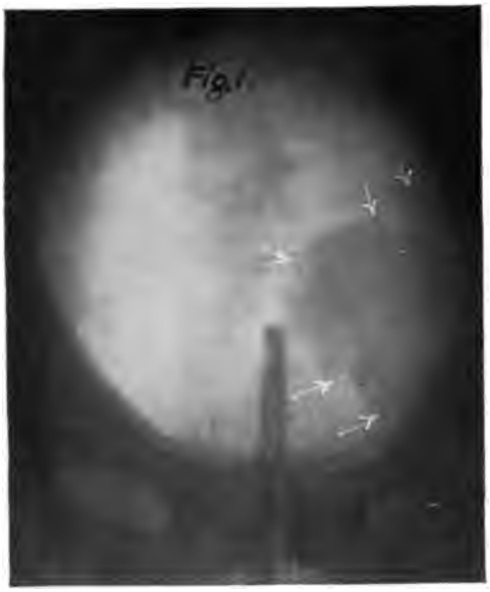

FIG. 1

thought would be that it is a benign enlargement of the prostate. If the upper or anterior surface of the prostate is irregular in outline or the enlargement involves especially one lobe, one would think of a beginning malignant infiltration, and especially if this shows extension beyond what is ordinarily recognized as the prostatic area.

Diverticuli of the bladder can also be demonstrated in this manner, especially if the diverticulum occurs on the lateral wall. If it occurs posteriorly or anteriorly it is less definitely demonstrated; generally the injection of an opaque solution into the bladder will give a better outline of a diverticulum, but there is nothing to prevent the use of both of these methods when necessary. The injection of an opaque solution has very much less advantage for demonstrating the outline of a tumor of the bladder, because the opaque solution will cover up the outline excepting when it is located on the lateral wall.

REPORT OF CASES

The following cases will illustrate the value of this method of examining tumors of the bladder.

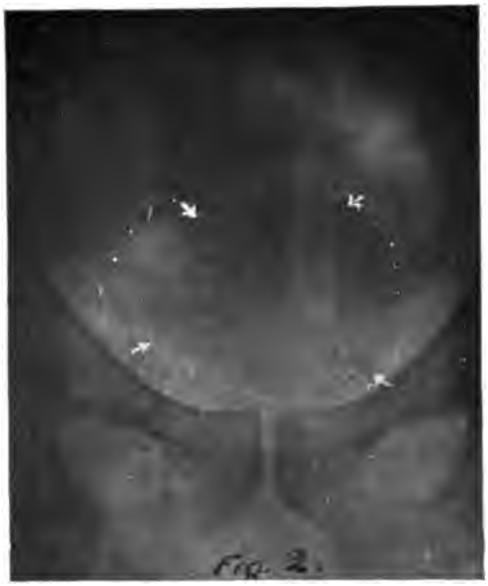

FIG 2.

CASE 1.—Mr. E. F. J., age fifty-two, referred by Dr. Ernest Laplace, April 7, 1919. The patient had hematuria for two months. The plates made of the bladder preceding the injection of air showed nothing abnormal. After the injection of air the anterior plate showed a tumor 2½ inches in diameter at its base, irregular in outline, elevated 1½ inches and attached to the left wall of the bladder. On account of its broad base, its irregular outline and its occurrence in a man of fifty-two, with hematuria as the first symptom and continuing during a period of two months, the diagnosis of carcinoma was made. Operation, as well as the pathological examination, confirmed this report in every detail. (Fig. 1.)

CASE 2.—Mr. I. G., age fifty-one, referred by Dr. Louis Schwarz, December 9, 1908. Roentgen examination of the bladder showed nothing abnormal. After the injection of air a tumor was found, shown best in the anterior plate, occupying the region of the prostate, but more especially the right side. The tumor was globular and irregular in density, fairly smooth in outline. On this basis the diagnosis of probable carcinoma was made. No operation was performed and when the patient was examined cystoscopically, February 8, 1911, more than two years later, a definite diagnosis of carcinoma was made. In this case a cystoscopic examination had been made just preceding the roentgen examination, but on account of the constant flow of blood, no definite opinion could be given as to the cause of bleeding or nature of the growth. (Fig. 2.)

CASE 3.—Mr. W. D. G., age seventy-two, referred for examination by Dr. Ernest Laplace, April 27, 1916. Original roentgen examination was negative. With

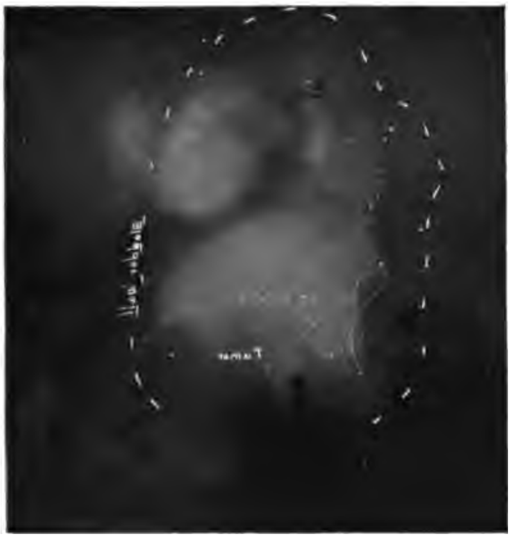

FIG. 3

the injection of air, an irregular tumor mass was found involving the entire prostatic area and extending upward on the left side of the bladder to the base of the bladder. In this case there was also associated the evidence of a diverticulum on the left side. (Fig. 3.)

CASE 4.—Mr. R. A. T., age fifty-five, referred by Dr. H. D. Deaver, February 9,

FIG. 4

1914. Patient had noticed a terminal hematuria during a period of three weeks. This was associated with pain along the right ureter. Injection of air and roentgen examination showed a small globular tumor about ¾-inch in diameter. Judged by its size and without recognizing any increase in breadth at the base, the probable diagnosis of a benign growth was made. This was confirmed later by cystoscopic examination by Dr. Alexander Uhle and the growth was destroyed by electro-coagulation. (Fig. 4.)

CASE 5.—Mr. J. A., age fifty-one, referred to me by Dr. Ernest Laplace, December 7, 1911, with a history of hematuria. Injection of air into the bladder and roentgen examination showed a broad, irregular tumor involving the prostatic area and extending upward along the right side of the bladder. A diagnosis of carcinoma was made and this was con-

firmed by operation by Dr. Laplace, and found inoperable. (Fig. 5.)

CASE 6.—Mr. L. J., age sixty-five,

FIG. 5

referred November 17, 1911, by Dr. J. K. Joffe and Dr. Leon Gans. During three years the patient has had considerable pain when passing urine. He was sent for diagnosis with suspicion of stone in the bladder. Injection of air and roentgen examination showed a large tumor about 3 inches in diameter extending upward from the prostate. It was smooth in outline and attached throughout its entire base to the prostatic area. This was confirmed later by a cystoscopic examination made by Dr. Gans. The probable diagnosis of carcinoma was made. (Fig. 6.)

CONCLUSION

1. Injection of the bladder with air is practical and with proper precaution is harmless.

2. Tumors can be definitely outlined, and when judged by their size, shape, and position in conjunction with the clinical history, a diagnosis as to their nature can be made.

3. This method will at times replace a cystoscopic examination; at other times it can be used to advantage in addition to the cystoscopic examination.

4. This method can be utilized when a cystoscopic examination is impractical on account of the field being partly obscured by blood.

5. It is less painful and generally less objectionable to the patient than the cystoscopic examination, and can be carried out wherever there is an expert roentgenologist.

FIG. 6

THE RADIOLOGICAL DIAGNOSIS OF TRANSDIAPHRAGMATIC HERNIA OF THE STOMACH RESULTING FROM WAR WOUNDS

BY DR. P. AIMÉ AND DR. J. SOLOMON

From the Radiological Service of the Val-de-Grâce Hospital, Paris, France.

Translated by Isaac Gerber, M.D.

TRANSDIAPHRAGMATIC hernia of the stomach is a condition whose rarity appears to have diminished appreciably since the present war. This is because of the large number of injuries to the diaphragm which have been produced. The more extensive use of the radiological examination in gastro-intestinal disturbances has been an additional help in discovering a large number of these cases that otherwise might have escaped clinical observation.

The difference beween the intra-abdominal and the intra-thoracic pressures during a strong inspiration or a fit of coughing, is sufficient to cause the passage of the abdominal viscera to a certain extent into the thoracic cavity, when the dome of the diaphragm presents a break in its normal continuity. This break in continuity may be either congenital or traumatic. Of all the abdominal viscera, the stomach is the organ associated most frequently with hernia.[1] A certain number of cases have been reported in which the hernia was made up of the transverse colon, or even of the spleen. Before the common use of the radiological method of exploration, the transdiaphragmatic hernias were almost always discovered only at autopsy. The clinical signs described by Patel and Jaboulay[1] are dyspeptic symptoms, vomiting, anginoid pains, tympany on percussion, borborygmus and gurgling with auscultation. These symptoms are usually vague or incomplete, and the authors add on page 336 that "a number of the diaphragmatic hernias have no clinical history and are merely autopsy findings. This is because they have no special characteristics, and it is extremely rare that their existence has been suspected, outside of well-marked accidents." It is just this lack of precision that requires the aid of radiodiagnosis. In spite of the primary importance of the radiological examination, from the point of view of operative indications, the most recent text-books (Bibliography, 2, 3) do not even mention the images furnished by this type of lesion. Patel and Jaboulay believe that radioscopy is a very illusory method of diagnosis. It is well to note, however, that this opinion was expressed in 1908. In his monograph Barjon[4] mentions a single case in which the diagnosis was doubtful—as between a pyopneumothorax with a double pocket and a hernia of the stomach. Since the war, in addition to the case described by Jean Quénu and Legrain, which was revealed by autopsy, a case of diaphragmatic hernia of the stomach and transverse colon has been reported by Dr. Pierre Wiart,[5] chief physician to the Surgical Automobile Ambulance No. 4. There have also been two observations of P. Lecène.[6] All of these depended upon the radioscopic examination. Wiart recognizes its great importance, as the clinical symptoms in his case were entirely those of a markedly obstructing gastric stenosis. Lecène believes that in the cases which he had the opportunity of observing the diagnosis was very simple and had been made before radioscopy; but he adds that "radioscopy gives the clinician a factor of certainty that he should never neglect. In our two cases the radiological examinations, at which we were present, constituted the real evidence, and confirmed the diagnosis in a positive manner." In regard to the use of the term "hernia," which has

been applied generally to this type of traumatic lesion, Lecène states that it is only "partially exact," because no hernial sac exists. He prefers the term "transdiaphragmatic intrapleural evisceration." It is well to remember, however, that the term "hernia" has been generally applied with good authority to such organs as the brain.[7]

Before describing the radiological findings in the different cases of transdiaphragmatic hernia that we have had the opportunity of studying, we believe it would be valuable to quote the autopsy protocol which has been kindly communicated to us by our colleague and friend, Dr. Finelle, with the authority of Professor Jalagines. The case was one of injury to the thorax, where the wound had been healed. During his leave for convalescence, three months after the injury, the patient was suddenly taken with an acute upset, vomiting of material looking like coffee and milk, and temperature reaching up to 104° F. He was brought to the hospital on account of the seriousness of his condition, and died three days later without any exact diagnosis being made. The anatomical conditions found when opening the thorax are most interesting, and help in the exact interpretation of the radiological images which we later observed in another patient suffering from the same injury:

"On opening the thoracic wall, the left lung was found completely retracted, and reduced two-thirds in volume. Its normal position was occupied by a mass having the appearance of brain tissue, which proved to be the great omentum, and stomach. These had herniated into the thoracic cavity. These organs were dark, slate-colored, and presented an apparent strangulation at the level of an opening in the left side of the diaphragm. This hole was of the diameter of about a five-franc piece, and was situated about 10 or 12 cm. from the anterior attachments of the diaphragm. An ulceration of the herniated stomach was seen at the apex of the pouch, in the vicinity of the greater curvature. Death resulted from the strangulation of the gastro-epiploic hernia, this strangulation having produced an ulceration of the stomach, followed by a copious internal hemorrhage, with communication into the lung." (Fig. 1.)

This interesting anatomo-pathological observation shows, first, that wounds of the diaphragm do not have any tendency towards spontaneous healing; second, that

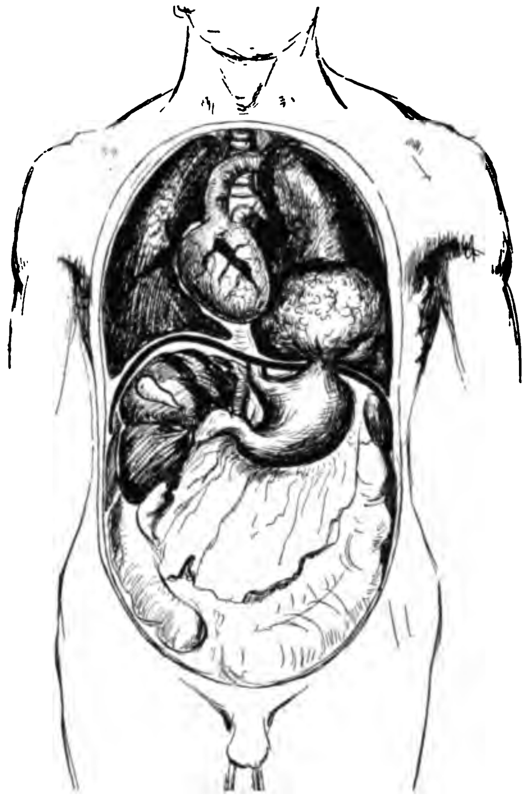

Fig. 1

the usual clinical methods of investigation are not capable of revealing a diaphragmatic hernia definitely; third, *that it is of the utmost importance always to employ the radiological examination in every case of wound of the thorax accompanied by digestive disturbances, if the patient's condition permits.*

Unfortunately this is not always the case. Often a perforation of the diaphragm requires an immediate surgical intervention. Such was the case with the two beau-

tiful anatomical specimens loaned by Major Martin, which are in the museum of the Val-de-Grâce, numbers 2658 and 2657. In the first instance, the case was one of a wound from below upward, with a diaphragmatic hernia of the spleen and stomach, which led to death in 15 hours. The second case was a diaphragmatic hernia of the stomach itself, from a wound extending from above downwards, which brought on death in 48 hours. A third specimen, which is placed at the side of the above, and is numbered 2659, shows a diaphragmatic hernia of the transverse colon, which had been unrecognized and had led to death by strangulation of the hernia *an entire year after the wound.* (Dr. Dupoy amb. 169.)

In addition, thoraco-abdominal wounds often involve the spleen or kidney, and make surgical intervention doubtful.

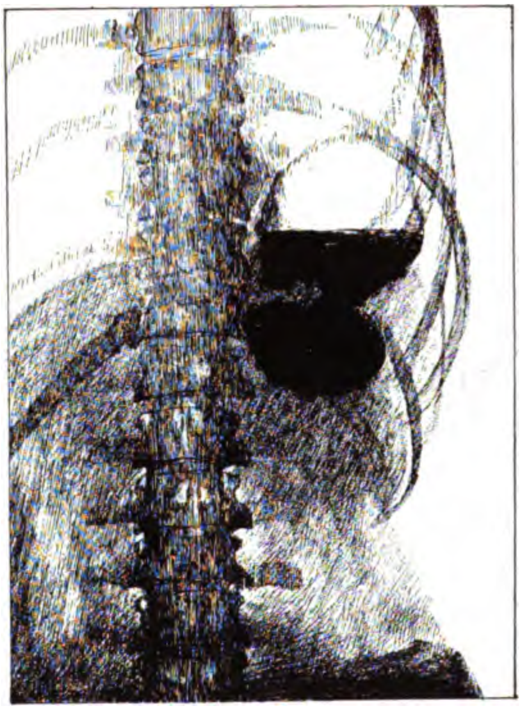

FIG. 2

FIG. 3

CASE I.—Sub-Lieutenant M. was sent to us at the Val-de-Grâce in May, 1917, for a radiological examination. He had been wounded on March 22, 1916, by a shell fragment, which penetrated the posterior portion of the left thoracic wall, going forward, from above downward. Although the wound was entirely healed, he presented dyspeptic symptoms. There was difficulty with digestion, accompanied by violent pain, several hours after meals, which did not stop until he lay down on his left side in a peculiar manner.

Radiological Examination.—The patient was first examined fasting in the vertical anterior position. A small amount of liquid was found still present in the stomach. We were impressed by the abnormal height of this liquid, which was much higher than the right diaphragm, and appeared to be surmounted by a transparent rounded cavity. This made us think first of a possible collection of air and fluid in the pulmonary field. The ingestion of an opaque meal showed clearly that we were dealing with the stomach, which presented a supradiaphragmatic and subdiaphragmatic portion, united by a constriction

...g to the level of the dia- ...upper portion filled first, ...ds. (Fig. 2.) The exami- ...ntal position gave the ...omaly. The opaque ...n the esophagus ...iaphragm, and ...d afterwards

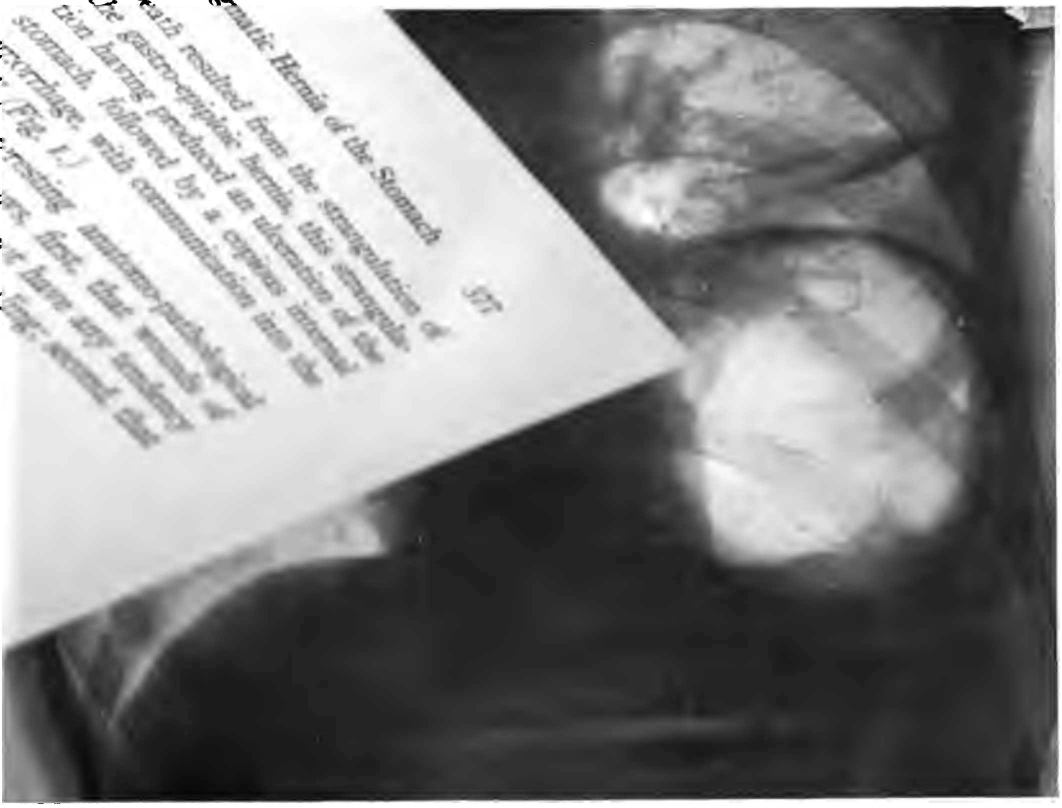

FIG. 4.

fill. It was obvious that the middle portion of the stomach had been drawn up through the hole in the diaphragm, while the cardia and pylorus remained fixed below. (Fig 3.)

The emptying of the stomach was considerably delayed. Twenty-four hours afterward it still contained opaque liquid. On July 4, 1917, Professor Walther operated by the thoracic approach, freed up the adhesions between the pleura and the herniated stomach and omentum, and reduced the hernia into the abdomen. The diaphragmatic opening was closed with three horse-hair sutures. At present the patient is entirely well, and his stomach functions normally. The latter was proved by another radiological examination.

CASE II.—Sub-Lieutenant P. was sent to us a short time later, in July, 1917. He had been wounded eight months before by a shell fragment, which penetrated the left side of his chest, traveling from above downwards, and from behind forwards. An attempt had been made to find the fragment through the wound of entrance, but without success. After the pleural effusion had slowly absorbed and the wound had healed, the patient was sent away to convalesce. His general condition however remained poor. He presented an extreme emaciation, and complained of difficulty in breathing, as well as of dyspeptic disturbances which were not relieved by any treatment. There was pain

after eating, often followed by vomiting of the food eaten.

Radiological Examination.—The examination was made in the vertical anterior position. Although the patient had eaten nothing since the previous evening, a definite fluid level was observed in the region of the stomach. The abnormal height of the fluid-level made us suspect a pleural effusion. The administration of an effervescing mixture demonstrated that this was in the superior pouch of the stomach. We were able to watch the gradual dilatation of this gaseous stomach pouch, which was situated above the dome of the left diaphragm. The dilatation was enormous, and compressed the lung very much like a pneumothorax. In reality we were concerned with an artificial gastro-pneumothorax. (Fig. 4.)

The diagnosis of transdiaphragmatic hernia was made, and further examination, continued with the opaque meal, gave very interesting results. The image of the stomach in the vertical anterior position is shown in Fig. 5. A constriction is seen, corresponding to the position of the diaphragm. Spontaneous mobility was absent, and provoked mobility was much diminished. No localized tenderness was noted on palpation. Palpation was extremely difficult on account of the high position of the stomach under the false ribs. The shell-fragment was clearly seen in the neighborhood of the vertebral shadow.

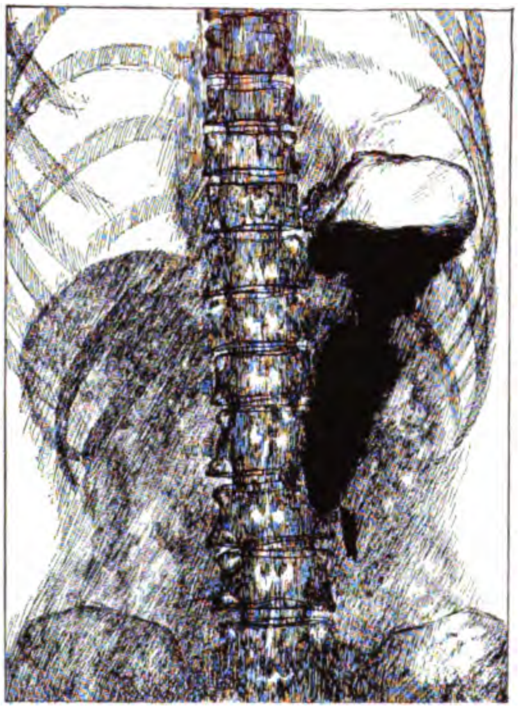

FIG. 5

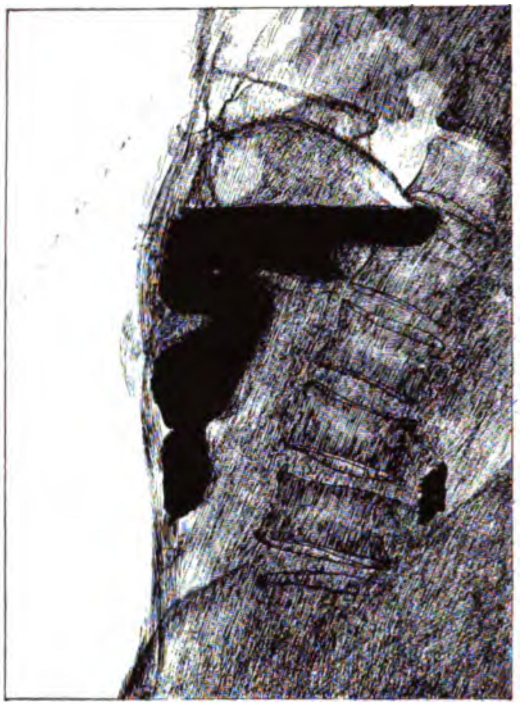

FIG. 6

The examination in the lateral position was even more instructive. It enabled us to localize the perforation in the diaphragm to a certain extent, and to estimate its dimensions. The level of the opaque liquid was clearly seen filling the narrow channel, and covering the entire dome of the diaphragm as far back as the shadow of the spine. The shell fragment was also seen. (Fig. 6.)

In the horizontal position we could follow the passage of the opaque bolus from the esophagus into the stomach. The cardia being fixed at the lower portion of the diaphragmatic dome, the opaque material

passed upwards above the diaphragm, and the filling of the pyloric portion took place later. The cardia and pylorus were situated one in front of the other under the diaphragm, so that the greater portion of the stomach spread out in the thoracic cavity, giving the general appearance of an enormous mushroom. (Fig. 7.)

The patient did not consent to operation, and was still living in August, 1918.

CASE III.—Private G. received several fragments of grenade in the left flank five or six months before coming to the hospital Saint Antoine for consultation. A radiological examination made previously had not called any special attention to the stomach. Clinically, however, an ulcer of the stomach was suspected. The plate (Fig. 8) shows a diaphragmatic hernia of the stomach, of traumatic origin. A constriction is seen at the level of the perforation through the diaphragm, the pylorus occupying the most dependent portion of the stomach, whose mobility was absent. The stomach appeared to be fixed in a rigid mass of perigastritic adhesions. The patient was not operated upon.

These three observations of transdiaphragmatic hernia of the stomach following trauma, show that when the stomach becomes herniated into the thorax it very quickly forms adhesions. While autopsies show that perforations of the diaphragm do not heal spontaneously, radiology demonstrates that the traumatic hernias of the stomach do not reduce themselves spontaneously, even in the upright position.

FIG. 7

The following observation shows that this is not the case with the congenital type.

FIG. 8

CASE IV.— Mr. M., 55 years old, a coppersmith by occupation, came in with the following history: There had been two attacks of hematemesis, the last two months previously, with loss of over fifty pounds in weight within a year. No tumor could be palpated. There was occasional regurgitation after meals, with some epigastric pain. The history suggested gastric ulcer.

The first radiological examination, made Jan. 31, 1918, showed a diaphragmatic hernia of the stomach. In the vertical anterior position, with the patient fasting, a rounded transparent pouch, with sharp outlines, was seen above the dome of the left diaphragm. The ingestion of an opaque meal furnished some very interesting results.

At first, the supradiaphragmatic pouch was seen to fill from the bottom, at the level of the constriction. Later the meal was

observed to travel through a narrow passage into a lower pouch. Gradually the stomach was entirely filled. The entire

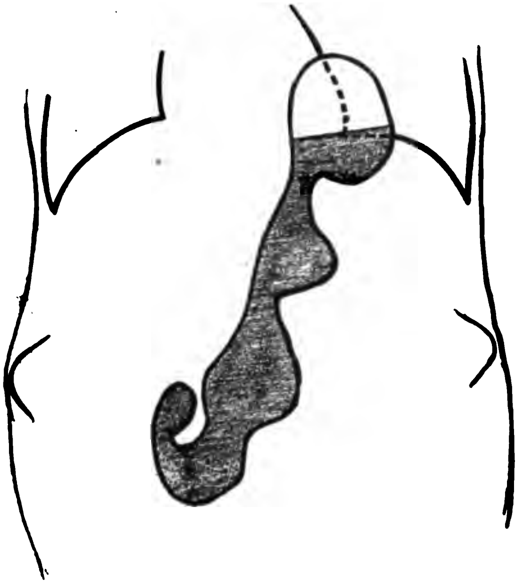

FIG. 9

subdiaphragmatic portion contracted very vigorously, and showed a very curious formation. (Fig. 9.)

FIG. 10

The examination in the horizontal position showed a large supradiaphragmatic pouch, and also a subdiaphragmatic portion that was elongated and markedly displaced to the right. (Fig. 10.)

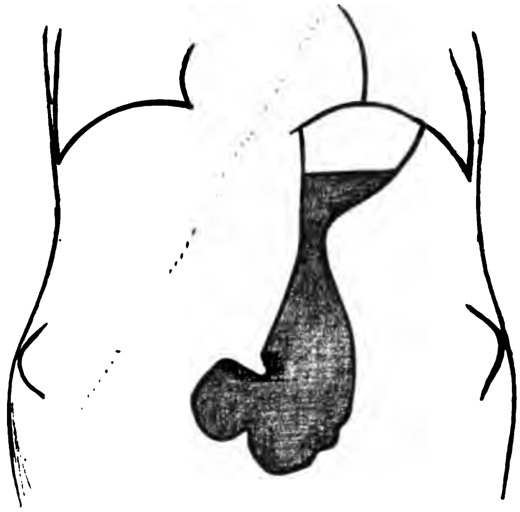

FIG. 11

Another examination made a week later showed a very surprising and probably extremely rare condition. The entire stomach had taken a position below the diaphragm, and every trace of hernia had disappeared. (Fig. 11.) The patient, who felt much better, had reduced his hernia spontaneously.

A third examination, ten days later, showed us again a small pocket of gastric air, situated above the diaphragm. The ingestion of the effervescing mixture (sodium bicarbonate and tartaric acid) again produced the same appearance of the stomach as at the first examination. In this case, therefore, we were dealing with a congenital hernia, which was partial and intermittent.

CASE V.—This case is not one of hernia, but represents a type of malformation, whose radiological appearances bear a close relation to those of true transdiaphragmatic hernia of the stomach.

Miss S., 20 years of age, was sent to us for a radiological examination of her chest and stomach. She presented clinical signs of a tuberculous cavity on the left side,

and also complained of digestive disturbances. The examination of the chest showed definite cavities in the left lung at the apex and at the level of the subspinous fossa. The vault of the left diaphragm appeared to be very high. The opaque meal in the vertical position showed a stomach the greater portion of which appeared to be intra-thoracic. (Fig. 12.) The cardia was at the lower third of the lesser curvature, and the pylorus was at the most dependent portion of the gastric shadow. Fig. 13 shows the appearance of the stomach in the horizontal position.

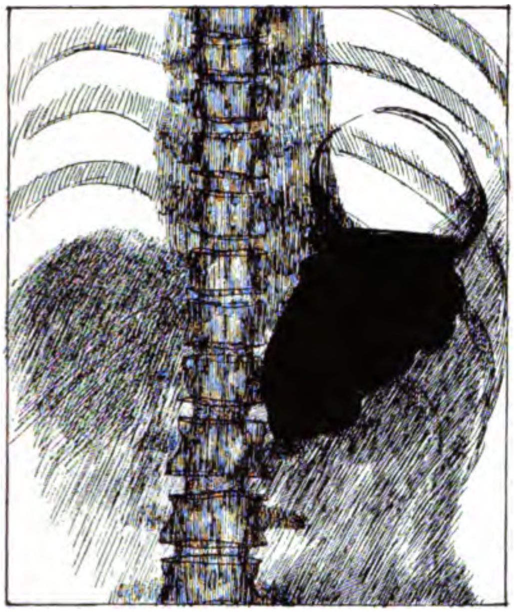

FIG. 12

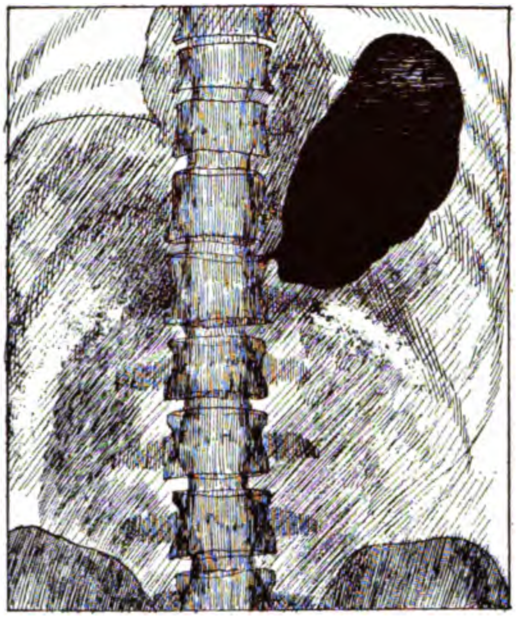

FIG. 13

In this case there is no hernia of the stomach through the diaphragm, but an abnormally high position of the diaphragmatic dome, carrying with it the upper part of the stomach, while the cardia remained fixed. This elevation of the diaphragm is really due to a congenital malformation. Another type of mechanism may, however, be suspected. This is the action of a pulmonary sclerosis which produces retraction of the corresponding diaphragm (as described by Dr. Béclère). In this particular case, it would be an extreme exaggeration of the irregularities and angulations of the diaphragm seen so frequently by radiologists in cases of pulmonary sclerosis.

From a study of these various cases, we see that in the case of true diaphragmatic hernia of the stomach, where the cardia and pylorus remain fixed, the stomach and omentum are drawn up through the opening in the diaphragm into the thoracic cavity, where they are fixed firmly only in the case of traumatic perforation. The congenital type seems to be characterized by the ease with which it can be spontaneously reduced. It would seem, therefore, that the adhesions between the stomach and the pleura are due to the infection incident upon the passage of the projectile, and not merely to the abnormal contact of the stomach. This is in accord with what we already know about the rapidity with which pleural effusions follow upon slight infections.

The radiological diagnosis of transdiaphragmatic hernia of the stomach may be made with certainty when a supradiaphragmatic pouch is seen, which dilates with an effervescing mixture, or fills with an opaque meal, and appears to be in con-

tinuity with the esophagus and the pylorus. We wish to emphasize the great value of the examinations in the lateral and horizontal positions.

We have been interested in collecting these few cases, as they are relatively rare. Among 5,000 radiological examinations made in the service of Dr. A. Béclère, there were only two cases of transdiaphragmatic hernia. The two cases observed in the laboratory of the Val-de-Grâce are the only two noted among the very large number of patients examined there during the war.

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RICE BODIES IN ANKLE JOINT

BY HENRY K. PANCOAST, M.D.

PHILADELPHIA PA.

Male, twenty-three years old, plumber, ship's fitter, U. S. N. R. F. Examined at the Naval Hospital, Philadelphia. He fell and hurt his ankle two years ago and was disabled one week. Ever since then he has been able to walk and dance without discomfort except that occasionally the ankle gives way like a sprained joint, and the pain lasts two or three hours, but without additional swelling. Examination shows a swelling of the ankle joint, without inflammatory manifestations. On palpation the swelling is found to consist of small movable bodies as shown in the roentgenogram. No tuberculous lesions or family history.

FIG. 1. ANTEROPOSTERIOR VIEW.

FIG. 2. LATERAL VIEW.

MASTOID STEREOROENTGENOGRAMS PRESENTING VARIATIONS*

BY BUNDY ALLEN, M.D.

Roentgenologist, University Hospital, State University of Iowa,

IOWA CITY, IOWA

THE objects of this paper are to outline two practical points relative to the roentgen examination and diagnosis of mastoid lesions, illustrating the technique of stereoroentgenograms of the right and left mastoid on a single pair of plates; to present a number of specimens in dried skulls which have had the mastoid dissected, and to offer a preliminary report of a number of patients demonstrating a variation of the mastoid cells, namely, pneumatic type on one side with a diploic type on the opposite side, which heretofore has been considered a very rare condition.

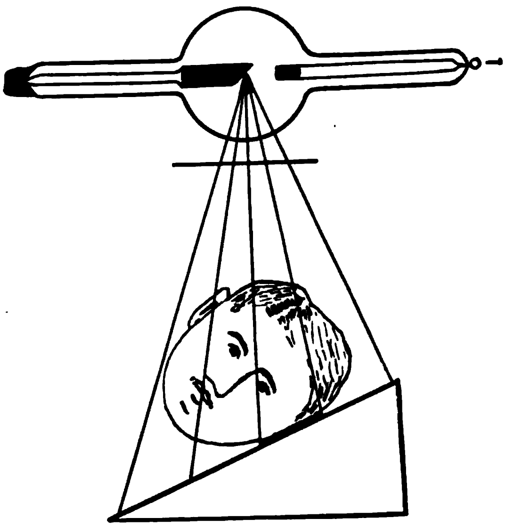

DIAGRAM A

In mastoid positions, the patient lies flat on the abdomen, as shown in the illustration, the face toward the right for the left mastoid, and vice versa. Doctor Ingersoll of Cleveland places the patient on the table on the left or right side. The only contra-indications to the prone position are advanced pregnancy, large abdominal tumor, etc.; but the prone position renders the patient more comfortable with less motion of the head than any other. The best technique for mastoid roentgenograms for diagnostic purposes is the stereoscopic, and the best results can be had by stereoscoping the mastoids, right and left, on a single pair of plates.

Stereoscopic mastoid roentgenogram technique is very materially simplified by a plate-changing device originated by the writer, and used by him for two years. The plate changer is made with a tunnel which will admit an 8 x 10 cassette at a 23° angle, over which is a celluloid cover allowing the admission of the cassette without disturbing the position of the patient. The device is also equipped with a lead cover 4 x 10 inches which protects one-half of the plate while the other half is being exposed, whereby the right and left mastoid may be made on a single pair of plates. This, of course, reduces the plate expense one-half; but the principal object is to be able to compare the right and left side while viewing the plates in a stereoscope, thus obviating the change of the roentgenograms. Diagram A illustrates the position of the mastoid and tube. The mastoid which we wish to roentgenograph is placed in contact with the plate-holder at a 23° angle, while the tube remains parallel with the table, so casting the principal ray as to give practically an exact reproduction of the cells nearest the plate, while the opposite or upper mastoid is thrown out of the field of examination.

Fig. 1 illustrates the head in position for exposure No. 1, with the tube shifted 1¼ inches from the center, tilted at a 5° angle, cassette No. 1 inserted, and the right half of the plate protected by lead. Exposure No. 1 gives the left eye stereoroentgenogram of the left mastoid. Fig. 2 is a repetition of Fig. 1, with the

*Thesis presented with application for membership in THE AMERICAN ROENTGEN RAY SOCIETY, 1918.

patient in the same position, plate-holder No. 1 removed, No. 2 inserted and the tube shifted 1¼ inches from the center and tilted at a 5° angle in the opposite

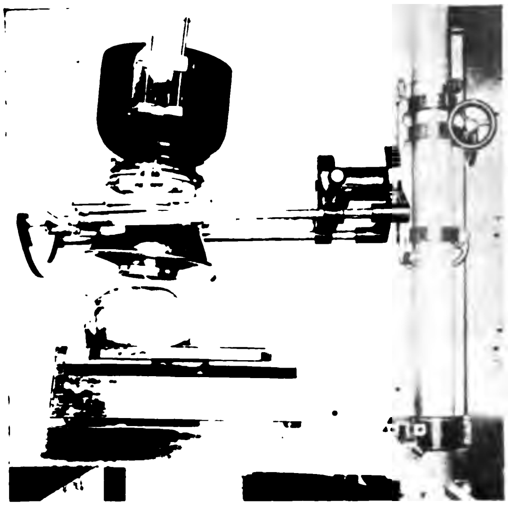

Fig. 1. Illustrating Head in Position for Exposure No. 1. Left Mastoid.

direction. The second or right eye stereoroentgenogram of exposure No. 1 is made. Fig. 3 shows the patient in position for the exposure of the right mastoid, which is

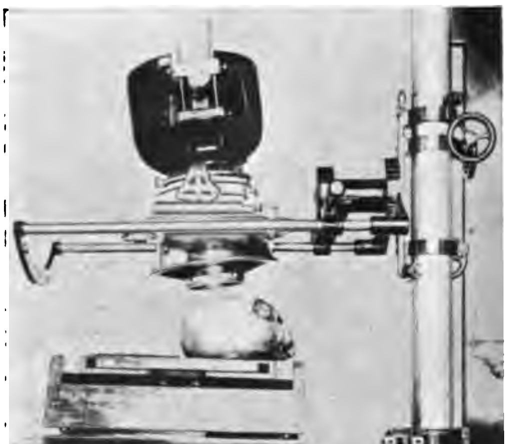

Fig. 3. Illustrating Head in Position for Exposure No. 1. Right Mastoids.

simply a repetition of the foregoing procedure for the exposure of the left mastoid.

Each plate may be conveniently labeled right and left, and may also identify the patient by the use of lead letters and numbers which remain in position on the

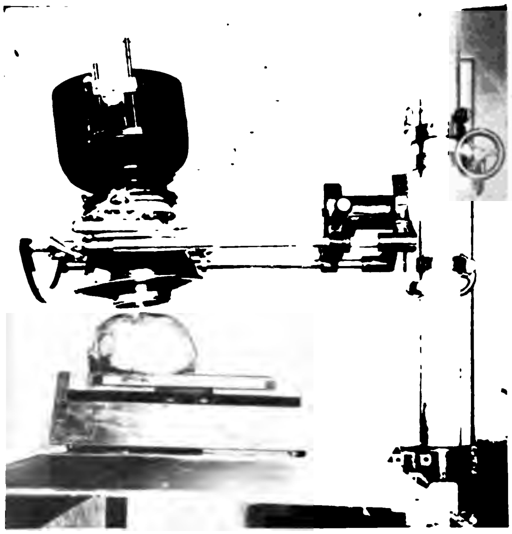

Fig. 2. Illustrating Head in Position for Exposure No. 2. Left Mastoid.

celluloid cover of the plate changer. These plates when developed are placed in the stereoscope, the one having the right eye

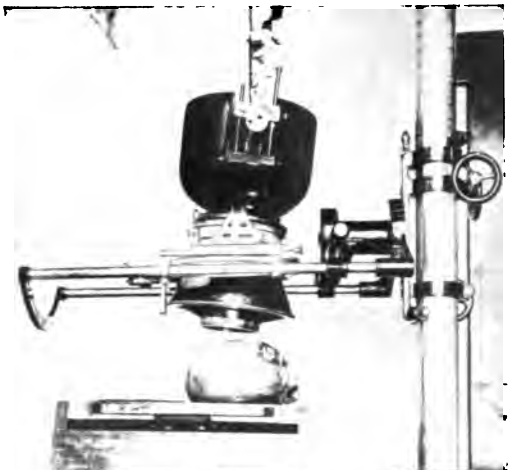

Fig. 4. Illustrating Head in Position for Exposure No. 2. Right Mastoid.

image in the right light box of the stereoscope, and the one having the left eye

image in the left box. With the glass side of the plate turned toward the mirror of the stereoscope, we view the mastoid from the inside of the skull, while with the

FIG. 5. SHOWING LEFT MASTOID IN SKULL NO. 36 OF THE LARGE PNEUMATIC TYPE

film side of the plate toward the mirror, we view the mastoid from the outside of the skull.

It is a well recognized fact that if a mastoid operation is necessary, the earlier it is done, the better the prognosis for a speedy recovery, with normal hearing in acute cases, and with less danger to the labyrinth and of brain infections in all cases. Stereoroentgenograms give us more or less positive information about the condition of the mastoid, and enable us to make an accurate diagnosis early. They also offer material advantages in the differential diagnosis of the involvement of the mastoid cells and postauricular edema.

Slight, or First Degree Mastoiditis.—The changes noted in the roentgenogram are chiefly cloudiness and haziness of the cell spaces, due to the presence of fluid, pus or serum instead of air. The cell walls are distinct. Slight changes are to be

FIG. 6. PHOTOGRAPH SHOWING RIGHT MASTOID IN SKULL NO. 36, OF THE LARGE PNEUMATIC TYPE.

noted around and just back of the antrum, and extending toward the tip. In severe,

FIG. 7. ROENTGENOGRAM OF SKULL NO. 36 SHOWN IN FIGS. 5 AND 6.

or second degree mastoiditis, in addition to the cloudiness of the cell spaces, distinct changes in the bone structure are noted.

The cell walls now appear indistinct and hazy, and may disappear entirely in places.

The different types of mastoid are the pneumatic and diploic.

FIG. 8. PHOTOGRAPH SHOWING LEFT MASTOID IN SKULL NO. 44 OF THE LARGE PNEUMATIC TYPE.

MASTOID VARIATIONS

Doctor Beck presents a pair of roentgenograms in the "Atlas of Radiography" illustrating a very rare condition, *i.e.*,

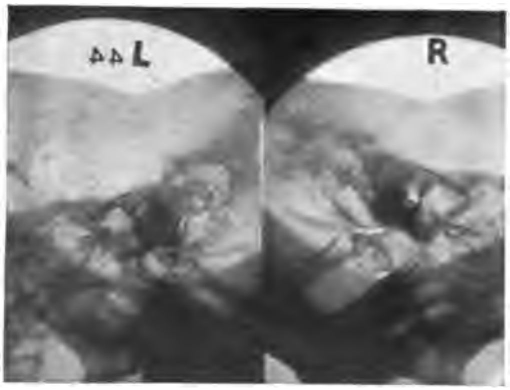

FIG. 10. ROENTGENOGRAM OF SKULL NO. 44 AS SHOWN IN FIGS. 8 AND 9.

one mastoid diploic, while the other is somewhat pneumatic. In more than three hundred heads roentgenographed in the mastoid position, I have found only this

FIG. 9. PHOTOGRAPH SHOWING RIGHT MASTOID NO. 44 OF THE DIPLOIC TYPE.

one case varying from the rule of symmetry in size, outline, and cellular consistency of both mastoids. Hakasa Hanasugi, in studying the topography of the mastoid in more

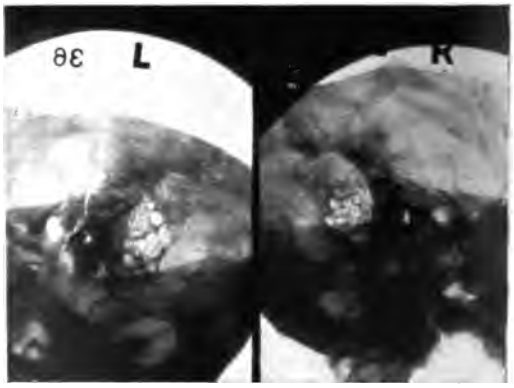

FIG. 11. CASE NO. 8268. GIRL AGE 13. SAME TYPE AS ROENTGENOGRAM FIG. 10.

than 4000 sections of heads, has found a similar condition, although not definitely stating this fact. Heinrich Neumann of Vienna told me in a personal communication that in all his experience in giving operative courses on the mastoid, he has

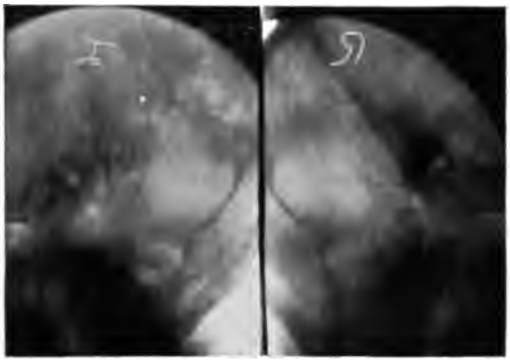

Fig. 12. Case 7576. Female Age 30. Same Type as Roentgenogram Fig. 10.

invariably found both mastoids to be of the same size and form.

This fact is significant for the reason that one may employ a roentgenogram of the normal side to determine the surgical topography of the affected mastoid process in the exenteration of the same. That this

Fig. 13. Case No. 6025. Female Age 21. Same Type as Roentgenogram Fig. 10.

condition existed in these two mastoid processes, I substantiated by operation. The patient was a woman 34 years old, who has severe symptoms of labyrinthian irritation, such as vertigo, dizziness and unbearable ear and head noises, which could not be controlled by the measures usually employed.

Figs. 5 and 6 are photographs of a

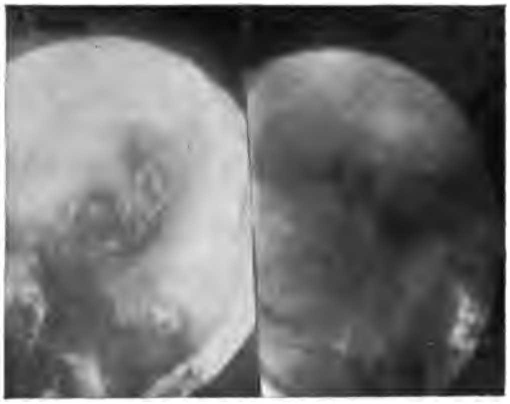

Fig. 14. Case 6343. Female Age 22. Same Type as Roentgenogram Fig. 10.

skull (specimen No. 36) from the State University of Iowa Anatomical Laboratory, showing large pneumatic type cells of the right and left sides. Fig. 7 is a

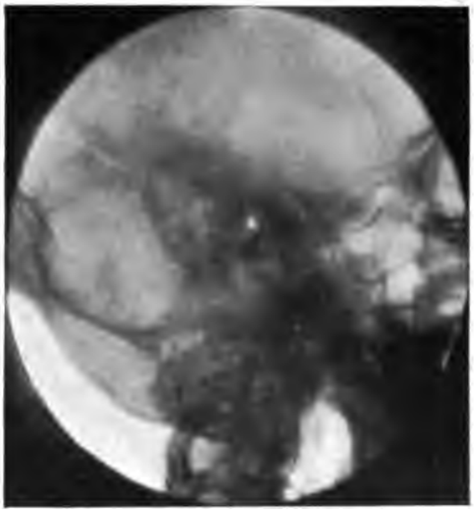

Fig. 13. Case 6025. Female Age 21. Same Type as Roentgenogram Fig. 10.

roentgenogram of the same specimen (No. 36), illustrating a normal symmetrical mastoid. Figs. 8 and 9 are photographs of

specimen No. 44 of the same laboratory. Note Fig. 8, which shows the left mastoid to be of the large pneumatic cell type, and Fig. 9 which presents the diploic type, both sides being typical specimens. Fig. 10 is a roentgenogram of specimen No. 44, typically illustrating the different types of cells in the same specimens.

FIG. 15. CASE 5534. GIRL AGE 14. SHOWING ASYMMETRY IN CELLULAR CONSISTENCY.

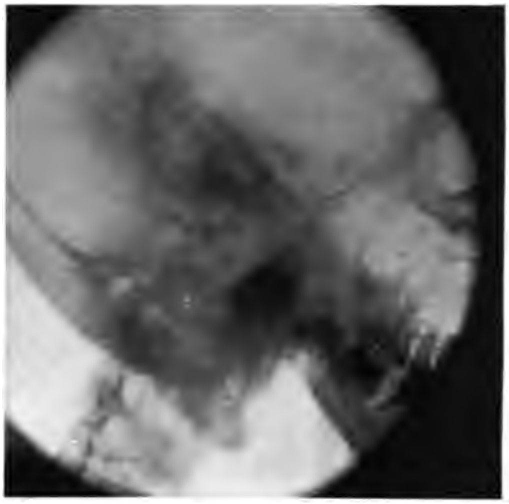

FIG. 15. CASE 5534. GIRL AGE 14. SHOWING ASYMMETRY IN CELLULAR CONSISTENCY

Figs. 11, 12, 13, 14 and 15 are plates showing cases varying from the rule of symmetry in size, outline, and cellular consistency of both mastoids. At the present time an investigation is being conducted in the University of Iowa anatomical laboratories of a large number of dried specimens and of all head dissections, to form a percentage report of the anatomical consistency of the mastoid. In the roentgenological department we are making a similar study of all cases referred to the department. We hope to publish at an early date a more extensive and complete report of the investigations relative to the mastoid, which will consist of the anatomical roentgenograms and all mastoidectomies.

AN ADAPTATION OF THE CROSS-SECTIONAL ANATOMY TO LOCALIZATION AND A CASE IN ILLUSTRATION

BY WILLIAM G. HERRMAN, A.M., M.D.

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MANY pages have been filled in the past few years describing various means for the localization of foreign bodies. Many have been most attractive theoretically, but practically some one or two of the simpler variations of triangulation were generally adopted by our war roentgenologists. This fact alone ought to be a deterrent to one attempting to write on localization. In addition, the end of the war and the lapse of time since the armistice, probably have greatly diminished whatever interest our roentgenologists, both at home and those returning, have held in different methods of localization.

However, as a matter of record, it may

be of interest to describe a simple and accurate method of using a cross-sectional anatomy for anatomical localization as adopted by the Roentgenological Department of Mobile Hospital No. 39. In wounds of the chest and the abdomen our surgeons were particularly desirous of knowing the relationships of the foreign

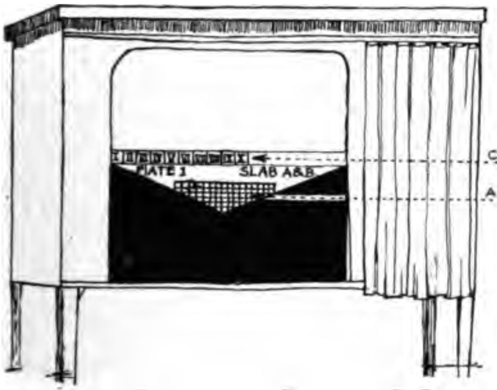


FIG. 1. A, TRANSPARENT GRIDIRON; C, CHARTS

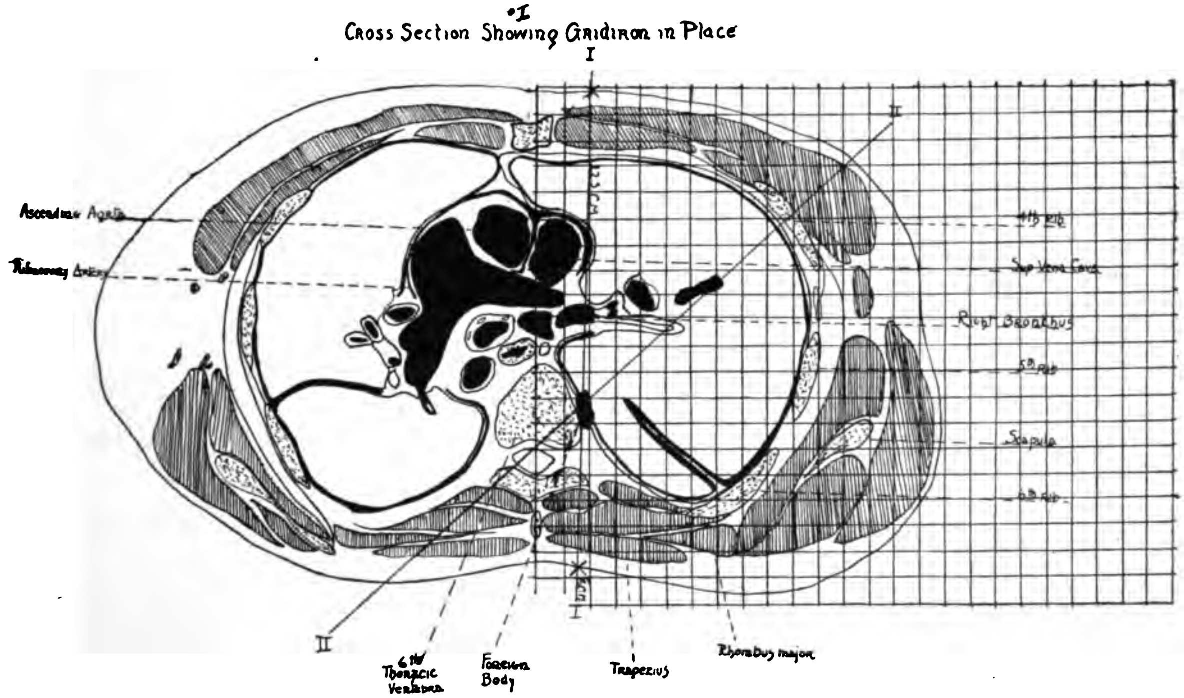


FIG. 2

body to the different viscera, as well as the depth. By the system described below we could not only give them this data, often with surprising accuracy, but by noting the wound of entrance we could also give the probable course of the missile. This method with a fair amount of detail could be used on the more serious cases even in a push; but its greatest usefulness came in those cases which for surgical or military reasons were not operated upon immediately on entrance but were kept until the peak of the load was passed. Oftentimes these cases demanded delicate surgery, and their chances were in inverse proportion to the surgical traumatism they received. Herein the method described was of great service. Nothing new is claimed for this method; it is simply an adaptation of one already well known.

The cross-sectional anatomy supplied was compiled by Johnson Symington, M.D., F.R.C.S., F.R.S., Prof. of Anatomy at Queen's University, Belfast. This anatomy consists of twenty-five charts of horizontal sections and two sagittal reconstructions of the neck, chest, abdomen and pelvis of a male subject, age fifty and weight approximately 150 pounds.

The horizontal plates are printed on heavy glazed paper pasted on cloth and are life size. They are contained in a case of cardboard which can be tied to the wall. By the use of home-made tabs of cardboard and adhesive plaster, one tab to each chart, these twenty-five charts were so card-indexed that they could be quickly separated from each other. An undeveloped film 8″ x 10″ was ruled off on the emulsion side with black ink into a gridiron composed of square centimeters. This film was then "fixed" and a transparent film with black lines was the result. (Figs. 1. and 2.) The cross-section slabs of the body from which the charts were made were approximately one inch thick with the exception of those of the neck. The first chart has two cross sections representing the neck from the third to the seventh cervical vertebræ. Each succeeding chart represents a cross section of the body at the approximate level of each vertebra from the first thoracic down. By means of the spinous processes of the vertebræ each chart can be located in reference to the living subject by posterior surface landmarks. However, in many cases it is more convenient to use anterior landmarks. Therefore a card was drawn up relating each chart to such surface landmarks as the sternoclavicular articulation, the ensiform, the line of the tenth rib, the level of the crests of the ilium, etc. (Fig. 3.) This was printed in black and red for easy reference and tacked to the wall. Each chart represented a level drawn either through one of these landmarks, or one or two inches above or below, as convenience dictated. The chart case with the charts in numerical order was hung on the wall of the scribe's desk with the gridiron in front. (Fig. 1.)

PLATE IA	4th Cer.	Vertebra	Ib 6th Cer.	Vertebra
PLATE II	1″ Above	Sterno	Clavicular	Articulation
PLATE III	Level "	"	"	"
PLATE IV	1″ Below	"	"	"
PLATE V	2″ Below	"	"	"
PLATE VI	3″ Above	Base of	Ensiform	
PLATE VII	2″ Above	" "	"	
PLATE VIII	1″ Above	" "	"	
PLATE IX	Level	" "	"	
PLATE X	1″ Below	" "	"	
PLATE XI	2″ Below	" "	"	
PLATE XII	2″ Above	Line of	10th Rib	
PLATE XIII	1″ Above	" "	" "	
PLATE XIV	Level	" "	" "	
PLATE XV	2″ Above	Level of	Umbilicus	
PLATE XIV	1″ Above	" "	"	
PLATE XVII	Level	Crest of	Ilium-umbilicus	
PLATE XVIII	1″ Below	" "	Ilium	
PLATE XIX	2″ Above	Ant. Sup.	Spine of Ilium	
PLATE XX	Level	" "	Spine	
PLATE XXI	2″ Above	Symphysis	Pubis	
PLATE XXII	1″ Above	"	"	
PLATE XXIII	Level of	"	"	
PLATE XXIV	1″ Below	"	"	
PLATE XXV	1″ Below	Great	Trochanter	

FIG. 3.

The roentgenologist first obtained his anterior skin mark and the depth beneath it in the usual manner. Following this he noted the relation of the skin mark to

one of the anterior surface landmarks mentioned above. This relationship, by the use of the key mentioned above, gave him the chart of the section of the body that contained the foreign body he had found. Immediately he called out to the scribe the number of the chart desired with the word "right" or "left" according to the side of the body involved. The scribe quickly drew out the designated chart by its tab and laid it flat, placing over it the transparent film or gridiron with one edge on the median line of the cross section and one edge, at right angles to the last, just touching the anterior skin line of the section and the body of the film covering the side designated. (Fig. 2.)

This can be done in much less time than it takes to read it. The roentgenologist then stepped to the scribe's hooded booth which was lighted by a red light. This allowed reading the chart without disturbance of accommodation. Quickly running his finger along the upper edge of the gridiron, the operator checked off a number of centimeters corresponding to the distance of the skin mark from the median line. Stopping here he ran down the black line beneath his finger until he had tallied the depth he had obtained by the fluoroscope. Beneath his finger at this point was the anatomic location of the projectile. If he desired, he could do this also from a posterior or a lateral aspect.

Patients vary in size, of course, but, in the experience of this department, military patients seldom vary in their anteroposterior diameter more than two centimeters over the dimensions of the charts. The sum of the anterior and posterior localizations or a pair of calipers will give this diameter. By deducting or adding the variance equally on the chart from, or to, the anterior and the posterior, a surprising accuracy in anatomical location could be obtained. In the majority of cases a glance at the patient would tell whether his variance from the charts would make any appreciable difference.

The writer apologizes for being unable to present more than one case in illustration but fortunately this case is especially well adapted for use in explanation.

CASE 528, H. C., private.—Was admitted from a Field Hospital on the night of Sept. 12 at 9 P.M. The admission diagnosis was as follows: "Severe gun-shot wound penetrating the right lung, wound of entrance posterior below the spine of the scapula near the posterior axillary fold." The condition of the patient, considering the nature of the wound, was satisfactory and presented no unusual clinical data.

Following his admission-bath and examination he was carried to the *x*-ray department. The *x*-ray report was as follows: "In the right chest a foreign body 5 x 8 mm. in size lying beneath the anterior skin-mark 13 cm. and beneath the posterior mark 6 cm. The foreign body moves with respiration and is in the right lung."

He was immediately operated on by Capt. A. M. Rowley, who did a debridement of the skin and the track of the bullet. The pleura was found perforated but was not at this time operated on, the wound being left open. The patient was carefully observed during the next few days to note the extent of the damage caused by the missile. Following partial recovery he developed a temperature with evening exacerbations rising to 103° and a physical examination showed signs of fluid accumulating in the pleural cavity.

On Sept. 16 a bacterial and cytological report was negative from a pathological standpoint.

On Sept. 17 a second *x*-ray examination was made. At this time fluid was found surrounding the lung from the apex to the base; the lung was compressed on all sides toward the root. The foreign body was again observed lying in approximately the same position as on the primary examination. The surgeon decided to do a thoracotomy; and to facilitate the operation, the location of the foreign body was accurately determined in four ways:

first, by the usual anterior and posterior skin marks with their respective distances from the foreign body; second, by the use of stereoscopic plates; third, by the use of a cross-sectional anatomy; fourth, by the use of the profundimeter.

The x-ray department desired to commit itself definitely on the question proposed by the surgeon as to whether the projectile lay within the lung substance or in the pleural cavity or partly in both. On the first examination it apparently moved with the lung in respiration rather than with the ribs. At this time anterior and posterior skin-marks and the note on respiration were considered as giving an accurate localization of the projectile, and only the first method of localization was used, the data being obtained by the 26° 34′ method. On the subsequent examination the movement of the missile was not sufficient to locate it accurately in the lung tissue. This was due to the accumulation of fluid, the collapse of the lung and the shallow respirations of the patient. The results of all four methods tallied and consequently the exact anatomical report which follows could be given: "The foreign body rests against the lung at a point opposite the body of the sixth thoracic vertebra as indicated in the accompanying chart." Fig. 4. shows the foreign body and the pathology observed at the second x-ray examination. The chart (Fig. 2) appended gives the result of the cross-sectional localization and the cross lines obtained by the profundimeter showing the same result obtained in each case. A rough sketch was given to the surgeon before the operation showing the essential anatomy. Both this rough sketch and the more elaborate one accompanying this paper were obtained by laying tracing paper over a chart from the anatomy mentioned above.

A word as to the profundimeter method used in this case is necessary. Due to the pain experienced by the patient at this time and to a desire not to move him more than was necessary, only two intersecting lines were obtained from four skin marks, or two lines of sight under the fluoroscope instead of the usual three.

On Sept. 19 the patient was again operated on by Capt. A. M. Rowley. "There was a resection of the sixth rib from the anterior to the posterior axillary line. The wound was enlarged by a Tuffier retractor. The lung was found collapsed and bound down by adhesions. Some pleuritic fluid was found. The eclat was located in the posterior border of the middle lobe attached to the parietal pleura and removed, pleuritic adhesions were

FIG. 4

freed, the cavity wiped with ether gauze, the chest closed and the air aspirated. Patient left the table in good condition."

Following the operation the patient's temperature dropped. The pleural cavity was aspirated twice following the operation and the laboratory reports on this fluid were negative pathologically. On Oct. 2 the patient was again x-rayed and the following report was made: "The right lung extends to the diaphragm near the heart but leaves the diaphragm above the costodiaphragmatic angle. The right lung is separated from the axillary border from the second to the sixth rib by a moderately dense shadow one inch wide. The base of the right lung is obscured by

a diffuse shadow, probably congestion. Interlobar bronchial markings of upper left lobe are heavier than normal." Shortly after this the wound being nearly healed and the patient being in a good condition, he was evacuated.

Several points in this case are of particular interest both surgically and radiographically. The history of the case as given above deals entirely with the treatment given in the advanced area, and both the patient and the x-ray department were fortunate in being able to make three different examinations with plates on two occasions. These examinations covered the case from admission to evacuation, when the patient was well on the road to recovery. In the second place, this case contrasts the relative importance of the various data that the radiologist can give the surgeon. The size and the probable damage caused by the projectile give the surgeon greater light on his task than a centimeter depth of the missile beneath some particular skin mark. This latter information is often considered the summum bonum to be derived from localization in war roentgenology. Thus the patient in this case was not immediately operated upon for removal of the projectile, since the x-ray examination did not reveal a rapid hemorrhage or effusion and he had the benefit of an operation only after the extent of the damage was observed clinically and by x-ray. Thirdly, this case illustrates how an anatomical location can be given, without distress to, or unnecessary movement of, the patient, quickly and accurately by the use of a cross-sectional anatomy. Stereoscopic plates and the profundimeter were only used to back up this method to the satisfaction of the surgeon and for the sake of a later report.

The writer desires in closing to say a word in tribute to Capt. James Squires, chief of the x-ray service in Mobile Hospital No. 39, for his unfailing kindly interest and advice at all times. His early departure for France and his untimely death from pneumonia after the armistice, are known to all.

SYSTEMATIC METHOD OF X-RAY EXAMINATION OF THE BONES OF THE FACE AND JAWS*

THE following notes, which are based largely on the work of Cieszynski, are intended as a supplement to the chapter on this subject in the United States Army X-Ray Manual. This addition is the result of a conference between the senior consultant in maxillo-facial surgery and the senior consultant in roentgenology.

Two methods are commonly employed in the roentgen ray examination of the jaws and teeth. One is the intraoral, by means of small films inserted into the mouth, limited almost entirely to the examination of individual teeth. The other is the extraoral method, which employs plates or larger films placed against the patient's face or cheek so that broader areas of the bones of the face and jaws may be radiographed.

The destructive injuries of the jaws which are of such importance in military surgery, require not only roentgen ray examinations for the demonstration of the actual injury, but also repeated examinations of the same patient for the study of the progress during the process of repair. For the best results of such comparative study it is essential that the roentgenograms should be taken in a definite and fixed position which can be duplicated with accuracy. The method to be described herein, if strictly adhered to, affords this desired accuracy, so that the same position can be reproduced on the same patient

* Published by authority of the Surgeon General's Office.

during the ofttime long period of treatment by the same roentgenologist and by others.

The position of the head and the incidence of the central ray may be so chosen that the desired portion of the jaw is not overlapped by the shadows of distant parts, e.g., occiput, spinal column, or by the corresponding parts of the opposite jaw. There is only one definite direction which complies with these requirements.

In exposures from behind forward (occipito-facial) the occipital shadow may be projected away from the region of the maxillary antrum by bending the head farther forward, i.e., by the apposition of the forehead to the plate, in which case, however, the lower jaw will be situated at a greater distance from the plate (Fig. 1, A).

In lateral exposures of the jaw, the shadow of the horizontal portion of the opposite side, the corpus mandibulæ, will be projected upwards and out of the way by an incidence of the central ray from below upwards (Fig. 1, F).

The vertical segment of the jaw will be projected to one side by rotating the head upon its vertical axis (oblique exposure).

Empirically it was found that for individual segments of the jaws the oblique exposures are the most appropriate, i.e., those in which the sagittal plane of the skull is aligned obliquely to the plate. The roentgenograms of the jaws thus obtained are bordered on one side by the ascending ramus of the opposite mandible, on the other side by the shadow of the spinal column (Fig. 1, C, D, E), the desired area being shown with the least degree of distortion.

Moreover, if in those cases the central ray be directed somewhat obliquely to the plate, even larger portions of the jaw will appear free from disturbing shadows.

In order to obtain the exact length of the tooth and to differentiate clearly the individual lines appearing in the maxillary antrum, it is recommended to direct the rays from below at an angle of 70 degrees.

To facilitate the determination of the correct angle for these roentgenograms and the making of the series of such roentgenograms in the same position at intervals of weeks and months, the following aids have been prepared: (a) an orientation table of typical extra-oral roentgenograms of the jaw (Fig. 1), and (b) a diagram of the incidence of the central ray in these positions (Fig. 2). In Fig. 2 the diagram shows the direction of the central ray and the position of the plate when the oblique views are desired. These positions with relation

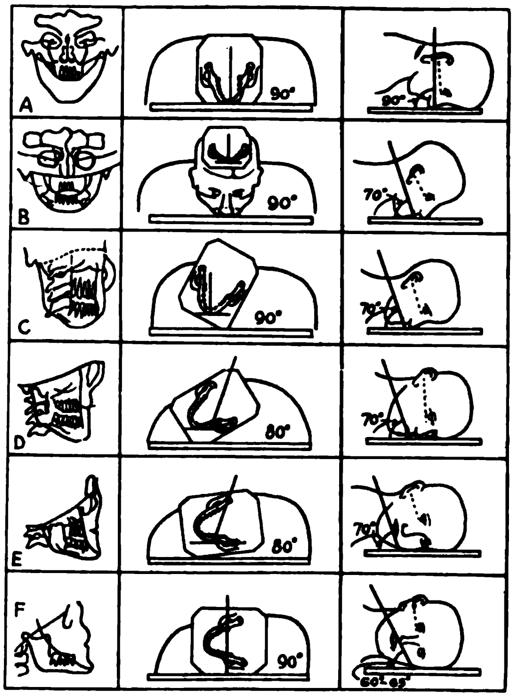


Fig. 1.

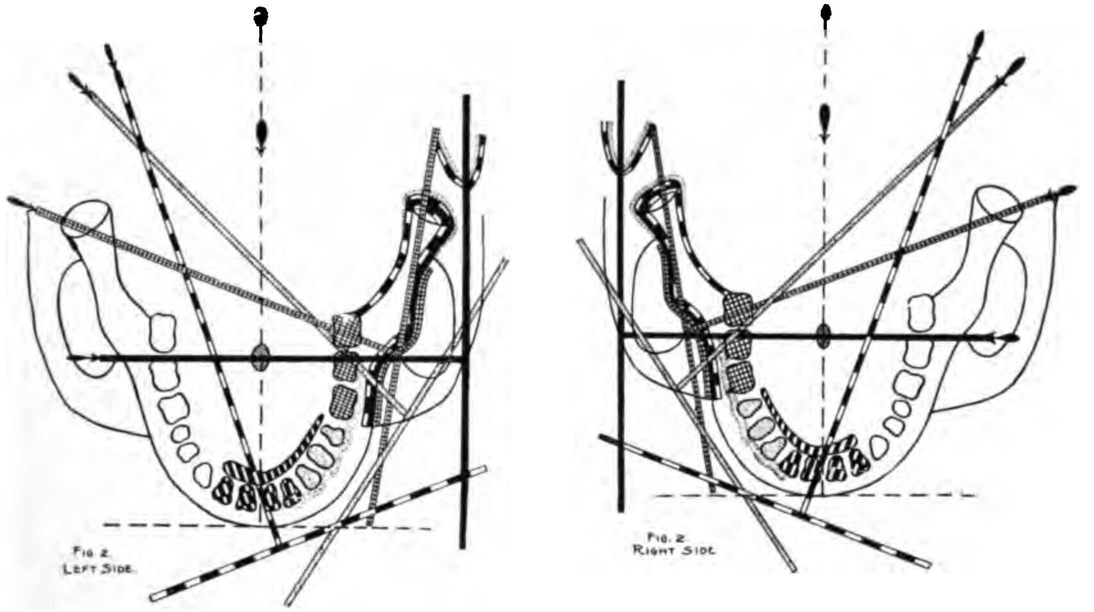
to the horizontal plane of the head are indicated by similar broken or dotted lines.

The diagram here given represents the right side. A similar diagram representing the left side may be reproduced by tracing the outlines on tissue paper or architects' tracing cloth; this tracing is then reversed and the lines are reinforced. The diagram card is made by pasting the two sheets back to back upon a piece of stiff cardboard, so that outlines of the diagrams will coincide.

To use this card, place it on the vertex

of the patient's skull with the sagittal line corresponding to the sagittal suture of the head, and the edge of the card parallel to Reid's horizontal line. Select the angle of the central ray desired and adjust the tube to correspond by the aid of diagram (Fig. 2).

In the Orientation Table (Fig. 1) there are three columns of illustrations, each containing six typical drawings. The first column gives general views of the roentgenograms of the jaws that may be clinically required, i.e., the one which shows the requisite portion of the jaw on the roentgenogram without the overlapping shadows of the vertebral column or the opposite side of the jaw; thus the part in question is framed by the shadows which would otherwise obscure it.



The required roentgenogram having been chosen, the drawing in the second column shows (1) the position in which the head should be placed with relation to the sagittal suture and to Reid's horizontal line; (2) how the diagram should be placed to accomplish this, and (3) the position of the plate with regard to the table and the direction of the central ray.

Finally, the corresponding sketch in the third column shows how the face must rest on the plate, whether with the forehead or the upper or the lower part of the face on it; also the angle at which the central ray must be directed from below upwards. This oblique incidence of the central ray—somewhat oblique from below as well as from the side—insures the advantageous general view of the roentgenogram and a correction of the length of the shadows of the teeth.

In the oblique roentgenograms the central ray should fall at an angle of 70 degrees and in the lateral roentgenograms from below at an angle of 60 degrees. The Kelley-Koett tube holder has a scale with a pointer upon the arm. Each mark upon the scale represents a tilt of 10 degrees. The tube support also has a sector with marks representing a tilt of 5 degrees. In case such a tube holder is not available, one may make use of a T-Square of cardboard, fastening the long arm to the cross piece with a rivet—the shorter base arm marked with lines indicating angles of 90, 80, 70 and 60 degrees. The edge of the long arm thus serves as a sighting line to secure the proper angle in tilting the tube holder.

Before taking the roentgenograms, make

a line on each side of the patient's face from the upper border of the external auditory meatus to the lower margin of the orbit, the Reid horizontal line. The position of the patient may be either prone or sitting, depending upon his physical condition. However, the position of the head with reference to the place and the central ray must be identically the same in either case. The head is immobilized by a bandage weighted by small sandbags hung on the ends or held by K. K. head holders, then the roentgen ray tube is adjusted to secure the proper direction of the central ray upon the jaw.

For general views of the ascending ramus of the jaw and in the fractures of the condyles of the jaw, the sagittal plane of the skull must lie parallel to the plate, and the patient's neck must be extended as far as possible. For the symphysis the slightly lateral position as in "C" may be chosen.

To obtain a view of the antrum, the nose should be slightly, if at all, flattened, and the forehead and the lower part of the face must lie close to the plate, upon which the central ray must be directed vertically below the occipital protuberance.

In the exposure from behind (forehead position), the upper part of the patient's face is close against the plate; in the chin position and in the third oblique position the lower part of the face is close against the plate; in the first and second oblique positions the margin of the lower jaw is about a finger's breadth away from the plate; in the lateral position from above and below, the median plane is placed parallel to the plate.

It is recommended that the Orientation Table (Fig. 1) be posted prominently in the laboratory for reference with regard to the desired exposure and position.

For the more expert, the diagram alone will suffice for the choice of the exposure and its accomplishment.

REVIEW OF STEPS

Patient is either sitting or placed in the prone or lateral position upon the table, face or cheek upon the plate.

The head is placed in the selected position by the aid of the diagram, which is placed on the vertex.

Immobilize the head with bandage weighted with sandbags.

The tube is tilted to the proper angle by the aid of the pasteboard triangle in two planes.

RÉSUMÉ

Roentgenograms of fractures of the jaws, to afford the greatest assistance to the surgeon, should not only demonstrate the bony injury to the best advantage, but should also be capable of exact reproduction during the process of repair.

An accurate and uniform method employed by all roentgenologists will insure accurate and uniform results.

The employment of the diagrams just described in determining the position of the patient and of the tube, affords a means of achieving accurate and uniform roentgenograms.

SARATOGA SPRINGS

SARATOGA SPRINGS, a city of 15,000 population, is situated 39 miles north of Albany on the main line of the Delaware & Hudson R. R.

It is approachable from Albany by the above route and also by the Hudson Valley Trolley, which latter line also communicates by way of Schenectady, a distance of 22 miles; from Boston and the east by the Boston & Albany R. R. to Albany and thence north by the above line or direct to Saratoga Springs by the Boston & Maine R. R.; from Montreal direct by the Grand Trunk and the Delaware & Hudson R. R.; from the west by the New York Central to Albany.

The city can also be reached from every direction by fine macadam roads running through a most delightful scenic country. The distance from Saratoga to New York is 182 miles; to Albany, 39 miles; Troy, 32 miles; Schenectady, 22 miles; Glens Falls, 22 miles; Lake Luzerne, 22 miles (elevation 635 feet); Lake George, 31 miles (elevation 331 feet); Lake Champlain, 39 miles (elevation 99 feet); Boston, 225 miles; Rochester, 225 miles.

The hotel accommodations are adequate and excellent. The headquarters of the convention will be at the Grand Union, which is centrally located, overlooking the beautiful city park where the Casino is situated in which the sessions and exhibits will be held.

Underlying this region, hundreds, and in some cases thousands, of feet below the surface, are great deposits of minerals. Pure waters trickling through these strata combine under infinite heat and pressure to form the mineral waters which have made Saratoga famous. Here Father Jogues was brought by his Mohawk captors in 1643, to be restored and refreshed by the "Medicine Waters of the Great Spirit." To this point, borne on a litter, sick unto death, Sir William Johnson was carried by the Indians from the valley of the Mohawk, to be nursed back to life at this great Indian healing place; and here, ever since, men have come from the ends of the earth to receive the benefit of Nature's largesse.

Saratoga is a city of beautiful streets, wide, elegant shaded drives, and of magnificent residences and beautiful modest homes. Lying under the foothills of the Adirondacks, its air is tonic and invigorating, charged with the odor of pine trees, and full of the freshness of the mountains.

THE STATE RESERVATION

On the high, dry Saratoga plateau, bordering the foothills of the Adirondack Mountains, the State of New York has established a reservation about mineral springs which from the earliest times have been recognized as yielding the finest mineral waters on the American continent. The State Reservation at Saratoga Springs is the property of the State of New York, having been established in 1909, and is maintained and operated by the State Conservation Commission under an administrative policy in complete accord with the dignity and position of the Empire State.

Approximately 450 acres of land are included within the Reservation. Upon this property are 122 natural springs and wells, including practically every naturally mineralized and naturally carbonated water in the Saratoga region.

The purpose of the State in assuming control over the Saratoga Springs was to stop their commercial exploitation for carbon dioxide gas and to insure the continuous flow of the water.

In the three parks upon the State Reservation, Geyser Park, High Rock Park and Lincoln Park, and in Congress Park, which is the property of the City of Saratoga, much careful thought and large sums of money have been expended. Congress Park must take high rank among highly

developed city parks. Its treatment is formal, whereas that of Geyser, the largest of the Reservation parks, is entirely naturalistic. In the development of Geyser Park every effort has been made to retain the wild, sylvan atmosphere that constitutes its chief charm.

At three different places upon the State Reservation, bath houses are conducted for administering various courses of treatment. They are run in accordance with the highest standards of the medical profession and many of the baths are given only under physicians' prescriptions. They are equipped to give all of the well recognized baths and hydrotherapeutic treatments, including Turkish baths and Russian baths, hot air and electric light baths, packs, douches and sprays, as well as salt rubs, alcohol rubs and massage. Neurovascular training is also available under thoroughly competent supervision.

The most important baths, however, are those given with mineral waters carrying a high supersaturation of carbon dioxide gas. It is these effervescing baths that are so effective in diseases of the heart and circulation.

At the Lincoln bath house in Lincoln Park are two large, out-door fresh-water swimming pools which are among the most popular features of the Reservation during the summer months.

The Saratoga Bath House, in the center of the city, where it is immediately accessible to all hotels and boarding-houses, is operated throughout the year, and every treatment may be obtained here. The High Rock Bath is operated only during the height of the summer season. The Lincoln bath house is operated all summer and as late into the fall as the demand for it continues.

HISTORIC AND SCENIC TOURS

Historic tours from Saratoga, following the lines of motor travel, cover a country which "has been the great strategic point in all the wars waged for the control of this continent."

In earliest colonial history the French from their settlements in Canada and the English from the Colonies contended for supremacy along the wonderful water route provided by the Hudson River, Lake George and Lake Champlain. Up and down this waterway swept marauding bands of Indians and rangers, and continental armies.

Again, in the Revolutionary War, the plan of the British for the conquest of the colonies provided for a drive south from Montreal by General Burgoyne, with a simultaneous drive up the Hudson from New York by Clinton. If they could have met in Albany, the Colonies would have been severed in half and the whole course of history upon the American continent might have been changed. Burgoyne, however, surrendered to General Gates at Old Saratoga, now known as Schuylerville.

The battle monument at Old Saratoga, standing upon an elevation at Schuylerville, twelve miles east of modern Saratoga. is the first point of interest for tourists, The route eastward follows just south of the course of a road cut by General Philip Schuyler in 1783 from near the site of the battle monument to the High Rock Spring. It was a mere wilderness trail, but nevertheless opened the way. At that time one went to Saratoga (now Schuylerville) to reach certain wonderful, but then nameless, springs. In time the springs absorbed the name of their nearest point of reference, while Old Saratoga became Schuylerville, after its founder.

Formerly the battle monument was almost the limit of one day's ride from Saratoga with horses and carriages. Now one may turn north up the river, passing in succession Fort Miller, Fort Edward, Half Way Brook in Glens Falls, Bloody Pond and Fort Gage near Lake George, finally reaching Fort William Henry on Lake George, which was the focus of much of the northern warfare. The return through Luzerne, Hadley, and Corinth to Saratoga passes along no historic coun-

FIG. 1. A GEYSER IN THE VALE OF SPRINGS

try, but one which in its scenic beauty is nevertheless equally satisfying. The whole trip, with the stops at all points of interest, makes but a day's run.

More extended journeys will include Lake George and Lake Champlain, by motor or steamer, or both. "By the Indians Lake George was called An-di-a-ta-roc-te, There-Where-The-Lake-Is-Shut-In, in reference to its mountain-bordered shores. The fact that its thirty-two miles of smiling loveliness formed an important section of the great waterway between the English possessions on the south and the French on the north, explains the sanguinary events that took place in its vicinity during the French and Indian War. Every mile of its mountainsides has echoed the merciless whoop of savages, and over its cool bosom glittering armies have passed, to return crushed by defeat or flushed with victory. To-day its procession of vacationists far outnumber the armies of the past."

In Lake George the State of New York owns seventy islands, constituting a part of the Forest Preserve under the jurisdiction of the Conservation Commission.

Lake Champlain is the largest body of fresh water in the United States aside from the Great Lakes and Lake Okeechobee in Florida. It is also one of the most beautiful; and the combined steamer route through Lake George and Lake Champlain makes one of the most attractive tours from Saratoga.

If one follows the path of the Great Carrying Place, from Fort Edward to Fort Ann on Wood Creek, near the southern end of Lake Champlain, he will traverse in a few minutes the eleven miles of portage that turned back many an expedition planned to settle the destinies of America. On Lake Champlain are the old forts, Ticonderoga and Crown Point, which have played such a prominent part in American history. They are now preserved for visitors, the one at Crown Point being the property of the State.

Schenectady is but a few miles from Saratoga and one of the afternoon sessions will be held in the Research Laboratory of the General Electric Company.

Schenectady is intimately connected with the early railroad history of America. In 1848 the first locomotive works were started here. The first railroad line in America extended from Schenectady to Albany and was put in operation in 1831. The second extended from Schenectady to Saratoga and was finished in 1832, while the third line connected Schenectady with Utica and was finished about 1835.

It is also of considerable interest to note that the engine and turret machinery of the "Monitor" of "Monitor and Merrimac" fame, were also made in this city.

South from Saratoga, through Ballston to Schenectady, we may run over the route that was so painfully traveled in 1767 by Sir William Johnson upon his litter. Seventy-seven years before, in 1690, the French and Indians from Canada had swept over it in the deep snows of February to massacre the sleeping inhabitants of Schenectady. From Schenectady it is but a short fifteen miles over the "gun barrel road," straight as the barrel of a gun, to the Capitol at Albany. The return journey up the historic highway of the Hudson will pass the site of fort after fort erected in colonial times to give armies and supply trains safe passage.

Westward up the Mohawk Valley, within easy motor run of Saratoga, is all historic country of central New York. Here were located the Iroquois villages, whose aboriginal inhabitants pitched their summer lodges about High Rock spring or encamped upon the shores of Saratoga Lake, which teemed with fish. Here on the Mohawk near Amsterdam were the headquarters of General Sir William Johnson, first visitor to the springs, and through the valleys were forts which marked early efforts to subdue the wilderness of central New York and ward off the French.

Touching Saratoga on the north and west, and reaching even to Canada and the St. Lawrence, is the State's great vacation ground—the Adirondack Mountains. Much of it is actually State owned and all of it is under protection by the forest rangers of the Conservation Commission. It is

made immediately accessible to motorists by State roads and a network of delightful dirt roads leading into the byways of the mountains.

Among the most traveled routes is that from Saratoga through Corinth, Luzerne, Lake George, Chestertown, and North Creek to Long Lake, all the way over a macadamized State road and amid mountain scenery that is unsurpassed in the east. A return may be made by dirt roads through Blue Mountain Lake and Indian Lake to North Creek, or down a back road that is somewhat primitive, though regularly traveled even by large cars, to Lake Pleasant and Northville and thence by a variety of routes to Saratoga.

Northward again one may follow State roads to Chestertown, Schroon Lake and Elizabethtown. There one route diverges to Plattsburgh and the North, and another swings westerly to Keene Valley, Saranac Lake and Paul Smiths. A complete circuit may be made around the Adirondacks through Potsdam, Gouverneur, Carthage, Lowville and Utica, and thus back to Saratoga. The ramifications are infinite and every turn yields fresh scenes and new surprises.

The city itself has miles of beautiful shaded drives. It lies upon the great Quebec, Montreal and Washington road. Macadam highways radiate from it in every direction. It is within easy reach (a few hours' drive) of the Berkshires, of the Green Mountains, of Lake George and the Adirondacks, and thousands of people from every State in the Union will find it an attractive stopping place from which to make these little tours over roads unsurpassed in the country. Saratoga is the center of so many attractions that no one need lack for entertainment. It is a city of magnificent shops and bazars, the home of some of the most modern manufacturing plants in the world, and withal it is so quiet and restful that the tired person seeking rest and recreation will not be disturbed within its limits.

Here, too, is a forest nursery established by the State of New York, where hundreds of thousands of forest trees are grown from the seed and shipped to the different parks for the reforestation of the woods and mountains of New York. This nursery is a source of instruction, inspiration and admiration to a large number of visitors every year. Smaller parks have been laid out and planted with forest and other trees covering many acres of land in the outskirts of the city, and are growing to be attractions of this great city of health.

Drive out South Broadway to the Lincoln Bath House, then straight on south to the Soft Sweet Spring. After seeing these grounds turn to the left into the Geyser Park, which contains 250 acres. In and around this park are beautiful drives, beautifully shaded, and here are the famous spouting springs, the Hathorn Nos. 1 and 2, the Coesa, Orenda and many others.

After seeing this park, drive out the west side to Ballston Avenue, up Ballston Avenue toward Saratoga, going past the State Nurseries, Vichy and Arondack Springs back to Broadway; turn to the right on Circular Street, then to the right to Union Avenue, out Union Avenue to "Yaddo," the beautiful house and park of the late Spencer Trask; then back to Union Avenue to the beautiful Saratoga Lake, if desired, back along Union Avenue to Circular Street, through Circular Street to Lake Avenue, turning to the left on Lake Avenue to Broadway, turning to the right up Broadway to Woodlawn Park, turning around and coming back to First Street, turning to the right to Clinton Street, turning to the right to see "Inniscarra," the beautiful summer home of Chauncey Olcott, then back to Broadway and the point of departure.

HISTORIC SCHUYLERVILLE

At the southern limits of Schuylerville, on the bank of Fish Creek, stands the famous country house of General Philip Schuyler, a place of unfailing interest to the historian and traveller, not only on account of the scenes which have been

enacted near it, but also on account of the noble character so intimately associated with it.

The chain of title is not without interest. In 1683 certain Mohawk Sachems conveyed the old Saratoga hunting ground to Cornelius Van Dyk, Jan Jansen Bleecker, Peter Philippsen Schuyler and Johanness Wendell; a quit-claim was also secured from a remnant of the Mohicans of any rights they might have in the lands. Thereupon Governor Dongan issued a patent for these lands to said grantees and their associates, Dyrick Wessell, David Schuyler and Robert Livingstone. Next year these owners met and divided the lands into seven parcels, for which they cast lots. Lot No. 5, all the land west of the Hudson and north of Fish Creek, on which Schuylerville now stands, was drawn by Robert Livingstone. Lot No. 4, south of Fish Creek and west of the Hudson, fell to Johannes Wendell, who by his will in 1691 devised it to his son, Abraham Wendell. In 1702, Abraham sold it to Johannes Schuyler, who built the old brick mansion and several mills, and otherwise developed and improved the property. His sons, Philip and John, Jr., succeeded him in the ownership of this property, and Philip, uncle of General Philip Schuyler, resided in this mansion until he was slain in the massacre of 1745. His nephew, General Philip Schuyler, of Revolutionary fame, inherited it, and on his death in 1804 it fell to his brother, John, and from John to his son, Philip, nephew of the General. Philip's representatives conveyed it to Colonel George Strover, whose heirs now own the place, and whose daughter, Mrs. John H. Lowber, resides on it.

When Burgoyne reached here on his retreat from Bemis Heights he took possession of the old mansion for his headquarters; and while the storm beat without and his hungry soldiers, wearied with marching, lay down to sleep in wet garments upon the sodden ground, the house gleamed with lights and rang with merriment and clinking glasses. The commander, with his mistress and some boon companions, spent the night in merrymaking, drinking and carousing; squandering the precious hours in which he should have been preparing his troops for flight, or taking precautions for defense. On October 11, 1777, the old brick house was burned by Burgoyne's orders upon the plea that "he was afraid the American forces would make some move under cover of the house."

The present house was built by order of General Gates within a few days after the surrender. Excavations made within a year or two have brought to light the cellar walls of the old mansion; and many relics, such as knives, shears and other articles, were found in the ruins. The old house stood a little east of the present one. The present house is practically unchanged in appearance since it was built and is of ample proportions. Many interesting relics are there preserved and shown to visitors with great courtesy, notwithstanding the pilfering of valuable articles heretofore.

Among them are a sword carried at the battle of Bennington by an aide of General Stark, with a sword, musket and cartridge box carried in the Revolution by John Strover, father of Colonel George Strover. A teacup is shown, from which it is said General Washington drank during a visit to General Schuyler; the saucer and a plate from the same beautiful china service were taken by some vandal visitor. A string of curious beads unearthed from the cellar of the old mansion, knee and shoe buckles, grubbing hooks, shells, grape, an old milk strainer 30 inches in diameter made out of a knot of wood in the year 1710; a bread bowl three feet in circumference, date 1710, also made out of a knot of wood; a blue-colored milk bowl out of which the great-grandfather ate his bread and milk when a boy; a black lace veil, embroidered by hand, over 100 years old; several gold rings 150 years old; a glass bell knob, from the house of Benedict Arnold; a copper coin with "Vora Cæsaria, 1787," on one side, and

on the other an escutcheon and motto, "E Pluribus Unum."

Then there are a miscellaneous assortment of Indian tomahawks in store; stone arrowheads, a large eight-inch shell, an iron weed-axe, an iron wedge, a petrified honeycomb, a string of brass beads dug from an Indian squaw's grave, silver shoe- and knee-buckles, a bolt from the burned door of General Schuyler's old home, an iron pulley from the old mill, an old-fashioned door knocker, an old bedstead with dimity curtains and valances, a brass andiron and tongs, a hickory chair over 100 years old, etc.

A letter addressed from General Schuyler to John Hancock, President of the Continental Congress, dated October 16, 1776, and written from Saratoga, asking "that provisions be sent at once," is also shown. So is a remarkable letter, written by one E. Mattoon, Esq., of Amherst, Mass. This Mattoon was an officer in the American Army. He writes to Philip Schuyler that "General Gates never would have captured Burgoyne had he not followed the plans of General Schuyler and taken his advice."

Conspicuous among the bold bands of Tories who infested the Hudson Valley during the Revolution was Thomas Lovelace, a man of great courage, size and energy, and one much feared among the patriots. In company with four companions, he was surprised one morning by three yeomen while lying by the camp-fire in a forest retreat. He was bound and taken to the barracks on or near the present site of Schuylerville for trial by court-martial. He was convicted as a spy and hanged a

FIG. 2. CONGRESS PARK

few rods south of the Schuyler Mansion, and buried in a standing posture. Some years ago, in digging gravel, the remains were found near the oak stump at the spot indicated to Colonel Strover by his father (who was present at the execution) as the burial place. The skull is shown at the mansion, almost as sound as when buried. Sad end of a brave man! His bones have been parted by strangers, and even his teeth stolen from their sockets by curious gazers.

THE SARATOGA MONUMENT

This splendid and imposing structure has been pronounced by competent judges one of the finest, if not, indeed, the finest, of its kind in the world. It was erected by the "Saratoga Monument Association," a corporation created for that purpose, under a perpetual charter from the State of New York. The object of its promoters was the preservation in granite, of statuary and allegorical pictures of the Nation's greatest crisis. The Association was formed in 1859, but comparatively little was accomplished until about 1875, since which time designs have been perfected, land secured and the shaft erected and embellished and grounds improved.

The base is forty feet square, of light granite, neatly axed, and the shaft of dark granite, rough hewn. Over the entrances on each side gables rise to a height of nearly forty feet, resting at their bases at each corner of the structure upon granite eagles, with folded wings, measuring seven feet across the back. The cornices of all the doors and windows rest upon polished granite columns with carved capitals. Over each entrance within the gable is a niche reserved for statuary. In three of these, seven-foot bronze statues are placed; General Schuyler, looking east; General Morgan, looking west; General Gates, facing north. The fourth niche, facing to the field of his most brilliant deeds, which would have done honor to Arnold had he met death upon the field, is and will stand a perpetual declaration that treachery can never be forgiven in a General of the United States. The first two stories are adorned with tablets and historical pictures cast in bronze, *alto-relievo*, representing the Continental citizens and soldiers, the progress of the campaign, and the principal characters of the period.

On the lower floor, to the left as one enters, is presented the first bronze relief. In the granite block or slab beneath it is cut the following: "George III and his ministers devising methods for enforcing the unjust taxation of the American Colonists."

SANITARIA

Several sanitaria have been established in Saratoga under the care and direction of physicians who have made a life study of hydro-therapeutics, as well as a modern well appointed hospital.

There is also a high-class race course with stabling for 2,000 horses, golf links, polo field and public tennis courts. There are several sylvan public and private parks. Saratoga Lake, three miles east, is reached by trolley.

Mt. McGregor, where General Grant spent his last days, now the site of a costly Insurance Company sanitarium (1,000 feet elevation), is six miles north.

Saratoga maintains an efficient and complete public school system which stands among the first in the state.

There are several private institutions of learning. The Skidmore School of Arts, an educational institution for young women, covers nearly two squares, and its equipment and facilities are among the best. St. Faiths School for girls is a growing and live institution.

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SIR WILLIAM CROOKES

1832–1919

The recent death of Sir William Crookes calls to mind many activities associated with his name. His numerous and varied achievements would occupy much space to record even in title, and produce a profound impression. One feels instantly the respect due to a life of unusually long and fruitful service. Born in 1832, his scientific career proper began in 1851; by 1857 he had published important contributions in chemistry, and in 1861 announced the discovery of the element thallium by the new spectroscope method. Probably few people think of Crookes as the discoverer of a new element, although thallium, its properties and compounds, received much of his attention for many years.

His studies of various phenomena in rarefied gases have been the starting point of much modern research. One has only to mention the Crookes radiometer and

SIR WILLIAM CROOKES

Crookes tubes to indicate how close was his work of the 70's to that of to-day. With such discoveries and so great success many men would have been content, but Crookes was still active on the problems of the constitution of matter, showing by his publications that he was not far from what we call the modern point of view.

In this connection it is particularly interesting at this time to read of the controversy between Crookes and certain

investigators of the continent, led by Goldstein, Hittorf and Pflücker. Crookes held that the cathode stream was actually matter in motion across the tube, while his opponents supported the view that it was a wave motion. Researches since 1895 have shown that while the particles were much smaller than molecules, as Crookes supposed them to be, nevertheless his general idea was quite in accord with the electron theory.

The discovery of radium must have delighted him immensely, and his experiments in radioactivity have been very valuable. The spinthariscope has served to show to thousands the effect of radioactive material, and yet it is much more than a popular curiosity, and has given important service in many researches.

His last great contribution dealt with the making of a suitable kind of glass to protect the eyes of workmen or others who were subjected to powerful artificial sources of light, and since 1914 Crookes' glass has been doing much to remedy unnatural conditions.

This does not by any means give all of his important work, but will serve in a measure to show his prolonged and successful endeavor. As a further emphasis of this point one may note the dates of the awards of the Royal Society, which gave him the Royal Medal in 1875, the Davy Medal in 1888, and the Copley Medal in 1904. What more could be needed to prove that at least occasionally there arises a man who can maintain preeminence by continued effort.

In another respect as well, Sir William Crookes commands great admiration. In days when specialization, often quite narrow, is the order, ability in more than one field attracts attention. Modern education seems to aim to fit men for particular lines of work, one for each man. Science, at least, suffers for the lack of men who can command in a broad field.

It is, then, almost with awe that one notes that the record already cited is quite incomplete, and that without exhausting the list he may select such further activities as these: Sir William was trained as a chemist; in 1859, established, and, until his death, edited the *Chemical News;* wrote several text-books; was an authority on precious stones and made diamonds artificially; as president of the British Association gave in 1899 a remarkable address on the world's food supply, advocating the need of the solution of the problem of fixing nitrogen; was interested in psychic phenomena, and not only made investigations of many, but published a book on spiritualism; was for years chairman of the Notting Hill Electric Light Company; received many prizes and medals in addition to those already mentioned; was knighted in 1897; received in 1910 the award of the Order of Merit.

Sir William belongs in a comparatively small group of distinguished men who should be termed not chemists or physicists, but scientists, or even better, and in a real sense, natural philosophers. His own statement made in his lecture on Radiant Matter shows the extent of his insight and imagination:

"We have actually touched the borderland where Matter and Force seem to merge into one another, the shadowy realm between the Known and the Unknown, which for me has had peculiar temptations. I venture to think that the greatest scientific problems of the future will find their solution in this borderland, and even beyond; here, it seems to me, lie ultimate realities, subtle, far-reaching, wonderful."

H. W. Farwell.

Notice to Teachers of Roentgenology

The Editor receives numerous requests from prospective students for information concerning courses in roentgenology. If those who wish to teach will please communicate with the Editor, prospective students will be referred to them.

ANNUAL MEETING

The Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY will be held in Saratoga Springs, September 3rd, 4th, 5th, and 6th. As this is the first post-war meeting of the Society, it doubtless will be well attended and the following list of papers promised indicate that the scientific side of the meeting is being well provided for.

The list of those who have promised to contribute papers is as follows: Drs. Ashbury, Ball, Beck, Boggs, Borzell, Bowman, Carman, Case, A. M. Cole, Coolidge, Dunham, Gerber, Gray, Groover and Christie, Hickey, Holmes, Hubeny, Johnston, LeWald, Manges, Moore, Murphy, Pancoast, Pfahler, Stewart, W. H., Van Zwaluwenburg, Walton, Waters, Wilson, and Dr. W. T. Bovie of the Harvard Cancer Commission.

Some of these papers will be read by title, but all will appear in the JOURNAL. The program will present unusual variety and interest.

Saratoga is admirably situated and is easy of access from any part of the country. On page 399 will be found a description of the meeting place.

Motor road maps and details may be had on application to Dr. Earl H. King, Chairman of the Local Committee of Arrangements, Saratoga Springs, New York, or from THE AMERICAN JOURNAL OF ROENTGENOLOGY.

The Local Committee, consisting of:

Dr. Earl H. King, Saratoga Springs, *Chairman*.
Dr. J. M. Berry, Albany.
Dr. T. J. Hull, Troy.
Dr. A. J. Marsh, Troy.
Dr. Edgar Birdsall, Glens Falls.
Dr. Chas. G. McMullen, Schenectady.
Dr. J. A. Herring, Schenectady.
Dr. T. J. Goodfellow, Saratoga Springs.
Dr. H. L. Loop, Saratoga Springs.
Dr. F. J. Ressequie, Saratoga Springs.
Dr. G. S. Towne, Saratoga Springs.

is doing everything for the comfort and convenience of members and guests.

The outline of the program is as follows:

Wednesday: Morning and afternoon sessions, with lantern slides in the evening at the Casino.

Thursday: Business session and possibly two papers in the morning at the Casino.
Afternoon at Schenectady.
Evening, a few papers with some entertainment after.

Friday: Morning session at the Casino; Afternoon at Mt. McGregor (not yet fully arranged); Evening, Dinner.

Saturday: Morning session at the Casino.

A detailed program will be sent in advance of the meeting to members of the Society and to all others who apply for same to THE AMERICAN JOURNAL OF ROENTGENOLOGY.

THE AMERICAN JOURNAL OF ROENTGENOLOGY takes this opportunity to welcome home roentgenologists from the service, and to wish President Bowen and the Society every success.

For general information about the meeting and program, address Dr. David R. Bowen, 235 South 15th Street, Philadelphia, Pennsylvania.

For information regarding the plate exhibit, address Dr. Thurmon A. Hull, 505 Broadway, Troy, N. Y.

For information regarding the commercial exhibit, address Paul B. Hoeber, 67–69–71 East 59th Street, New York City.

PUBLICATION OF PAPERS READ AT THE RADIUM SOCIETY MEETING

The use of radium has become so interoven with that of roentgen rays in the treatment of malignancy and other conditions that many roentgenologists who are doing general therapeutic work have found it essential to possess more or less radium. It is true that either agent may be a substitute for the other in many instances, but one who treats a large number and variety of cases finds that radium has its distinct indications, the roentgen rays have theirs, and in a large number of instances

both can be employed advantageously together, whereas either alone would probably fail.

The roentgen therapist must be familiar with the indications and the advantages of radium, and it is important that he be able to employ it when its use is desirable or imperative. Naturally he should as thoroughly understand the technic of its use as he does that of the roentgen rays. It might be well to add that the reverse is true as to the radium therapist being familiar with the indications and advantages of the use of the roentgen rays.

The programs of our annual meetings have always been crowded with papers on roentgen diagnosis and treatment, and the admission of papers on radium therapy has been in a measure tabooed, probably with the exercise of good judgment, except in rare instances in which the use of radium has been discussed in connection with roentgen therapy or the two agents have been compared. This custom will doubtless have to continue. In order that our members may be kept in touch with the advances made in radium therapy, the proposition was made by the editor to some of the officers of the American Radium Society to publish the papers read at the last meeting of that Society at Atlantic City, June 9, 1919. The proposal was accepted by the officers of the Radium Society, but had been made too late for any official action on the part of the American Radium Society to make The American Journal of Roentgenology its official organ. It is to be hoped that the publication of these papers will be of mutual benefit.

The American Radium Society has now become a representative scientific body, and its membership roll includes the names of many of the members of the American Roentgen Ray Society. It is growing rapidly, and its few years of existence have shown that there is a distinct and valuable work for such a body.

In discussing the use of radium and roentgen rays singly or in combination the subject of a change in terminology has again arisen.

The following papers were read at the last meeting of the Radium Society:

1. The treatment of Malignancy by Combined Methods. Russell H. Boggs, M.D., Pittsburg.

2. Radium in Combination with Roentgen Rays, Electro-Coagulation and Surgery, in the Treatment of Malignant Disease. George E. Pfahler, M.D., Philadelphia.

3. A Comparative Study of the Action of Radium and Roentgen Rays. Albert Soiland, M.D., Los Angeles.

4. The Physico-chemical Therapy of Radium as Administered in the Treatment of Chronic Arthritis. C. Everett Field, M.D., New York.

5. The Value of Radium in Curing Disease, Prolonging Life and Alleviating Distressing Symptoms, W. H. B. Aikins, M.D., Toronto.

6. Treatment of Carcinoma of the Uterus. John G. Clark, M.D., Philadelphia.

7. Three Years' Experience with Radium in Cancer of the Uterus. Ernest Charles Samuel, M.D., New York.

8. The Technic and Pathology of Radium Therapy. Henry Schmitz, M.D., Chicago.

9. Treatment with Deeply Planted Radium Emanation Tubes. Henry H. Janeway, M.D., New York.

10. The Technic of Radium Application in Cataracts. Isaac Levin, M.D., New York.

H. K. Pancoast.

TRANSLATIONS & ABSTRACTS

In the "American Atlas of Stereoroentgenology," Vol. VIII, Hill and Thomas describe the "Technique of Making Stereoroentgenograms of Both Mastoids on a Single Pair of Plates."

The technique is quite simple and does not require much more time than the ordinary examination. We give herewith a rather detailed description of the technique, in which it will be noted that the number of steps necessary to complete the examination is reduced to a minimum.

The patient lies on the table on the left side, with the side of the head resting on a small table (such as is used with the Kelley-Koett eye localizing apparatus), which is lead-lined except over an area five inches wide across the center of the table. The ear is turned forward to prevent the shadow of the cartilages of the ear obscuring the radiograph of the mastoids. The head is placed so the tip of the mastoid lies over a centering spot on the middle section of the table where there is no lead lining.

The tube is placed so that the line of the principal ray passes through the head at an angle of twenty degrees above a line through the auditory meati.

The stereoscopic adjustments have been made before the head is placed on the head table, so the line of the principal ray shall always focus on the center spot over which the mastoid is placed. Then on the left half of one 8 x 10 plate marked "R" for instance, the right eye radiograph of the left mastoid is made. This plate is then removed from the slide in the head table without the patient's position being changed, the tube is shifted for the left eye image, and on the left half of a plate marked "L" is made the left eye radiograph of the left mastoid. The patient is then turned on the right side with the right mastoid placed over the centering point as was the left, and on the right half of the plate marked "L" the left eye radiograph of the right mastoid is made. This plate is then removed, the patient remains quiet, plate "R" is reinserted in the slide of the head table so that the exposure will come on the right half of the plate. The tube is shifted for the right eye, and a radiograph of the right mastoid for the right eye is made. This gives right eye radiographs of each mastoid on the plate marked "R" and the left eye radiographs of each mastoid on the plate marked "L."

These plates when developed are placed in the stereoscope, the one having the right eye image in the right light box of the stereoscope, and the one having the left eye image in the left light box. With the glass side of the plates turned toward the mirrors of the stereoscope we view the mastoids from the inside of the skull, while with the film side of the plates placed toward the mirror we view the mastoids from the outside of the skull.

F. H. Baetjer, M.D., and Julius Friedenwald, M.D., Baltimore, Md. Certain Clinical Aspects of Peptic Ulcer with Special Reference to Roentgen Ray Diagnosis as Observed in a Study of 743 Cases. (*The Johns Hopkins Hospital Bulletin*, Vol. XXIX, No. 330, August, 1918.)

The authors in the following report have reported 743 cases of peptic ulcer which were studied with special reference to the roentgen ray examination, and this report illustrates the close relationship on which the clinical and roentgen ray examinations checked up.

The cases were first gone into clinically and then, without any evidence as to the nature of the disorder, they were studied by means of the roentgen ray and a report made. The two reports were then placed side by side in order to determine how closely the clinical and roentgen ray diagnoses corresponded.

The 743 cases were divided into three groups.

Group I. Cases proven by operation number 185. Diagnosis proven.

Group II. Cases presenting positive clinical and roentgen ray findings of gastric ulcer number 323.

Group III. Cases presenting doubtful signs and symptoms but lacking some definite, positive sign. Roentgen ray findings, however, in the larger number of these were quite definite and numbered 235.

Group I represented the most important in this series of cases inasmuch as the diagnoses were definitely confirmed by operation of the 185 patients representing the first group; 132 were males and 53 females, and the vast ma-

jority of cases occurred between the ages of twenty and forty.

A direct history of ulcer was shown in 163 cases (88 per cent) with occult blood occurring in 108 cases (84 per cent). The gastric secretion was examined in 164 cases.

Normal acidity was observed in 54 cases or in 32 per cent.
Hyperchlorhydria was observed in 68 cases or in 41 per cent.
Hypochlorhydria and anacidity in 42 cases or in 26 per cent.

The high percentage of hyperchlorhydria findings in this series of cases, the authors state, is due to the fact that the Rehfuss fractional method was employed in the determinations.

The roentgen ray findings are interesting in this series of cases, inasmuch as the results were definitely checked up by operation. Out of this series the roentgen ray findings were verified in 147 cases (79.4 per cent). Of these 147 cases the ulcer was duodenal in 68 (46.2 per cent); gastric in 53 (36 per cent); pyloroduodenal in 17 (11.5 per cent) and in the remaining 8 cases (5.2 per cent) undetermined. The roentgen ray diagnosis in these 8 cases was based chiefly upon the functional activity of the stomach, and not to a persistent filling defect.

There remain 38 cases (20 per cent) in this series in which the roentgen ray findings were either not characteristic or pointed to other conditions.

Group II. In this group are included those cases which presented such typical clinical signs as well as positive roentgen ray findings of ulcer that the diagnosis could hardly be questioned. There were 323 cases in this group.

Roentgen ray findings in this group were even more definite than in Group I. Of these 323 cases positive roentgen ray findings were obtained in 272 (84 per cent). Of these 272 cases, 117 were duodenal ulcers (43 per cent); 109 gastric ulcers (40 per cent); 38 pyloroduodenal ulcers (14 per cent) and in 8 (3 per cent) the location remained undetermined. A filling defect was absent in the 8 undetermined cases; but here too the functional activity of the stomach was so definite that a positive diagnosis of ulcer was made with almost absolute certainty.

In this group there were 51 cases (15.6 per cent) in which the roentgen ray findings were either uncertain or pointed to some other pathological condition.

Group III. In this group of cases the authors have placed those in which there were some elements of doubt, yet which on the other hand presented many of the characteristic manifestations of ulcer.

"We can practically always rule out the presence of a single duodenal ulcer, but we cannot always rule out gastric ulcer. The main distinction lies in the fact that in an irritating lesion of the stomach, such as ulcer, the consequent hypermotility causes a tonic contraction of the pylorus with retention of the gastric contents over a shorter or longer period, as well as a deformity, according to the situation of the ulcer.

"On the other hand, in lesions of the duodenum we have indeed a hypermotility not only of the duodenum but of the stomach itself; but in this case we do not have the spastic condition of the pylorus, consequently the hypermotility produces a rapid emptying of the stomach contents.

"Simple ulcer of duodenum uncomplicated by adhesions, stomach empties in from fifteen minutes to an hour, the contractions are uniform, and there is no tendency toward hourglass formations of the stomach. The pylorus is patulous and bismuth flows through quite freely. Duodenum is in very active contraction, and many cases show a deformity in some portion of it. At times bismuth can be seen running along either side with the defect between the two bismuth currents.

"In gastric ulcer just the reverse is seen. Primary quick expulsion of contents and then the spastic condition of the pylorus appears with hour-glass formation and we have a retention, lasting anywhere from four to six hours according as the lesion is simple or is complicated by adhesions. In addition a filling defect is usually observed which remains constant."

The greatest difficulties arise in the diagnosis of complicated cases; that is, when adhesions are present, due either to the healing ulcer, or to inflammations connected with one or other of the organs in the abdominal cavity. This condition so frequently masks the usual findings that it is often impossible to determine whether we are really dealing with an ulcer or whether a lesion of some other organ is causing

the symptoms, and the gastric findings are due to a purely reflex condition or to a spasm.

Although ulcerations are not always revealed by roentgen ray examinations, there are many cases of ulcer doubtful from a clinical standpoint in which the ray will clear up the diagnosis. In two of these cases the clinical signs were indefinite but suggested an appendicitis; the roentgen ray was definite as to ulcer in both instances. Appendectomy was performed and only temporary relief was afforded. There was subsequent gastric hemorrhage and finally operation revealed an ulcer in each instance.

CHARLES A. WATERS.

PITUITARY HEADACHES AND THEIR CURE. (*The Lancet*, April 19, 1919, p. 664.)

Attention is directed by Dr. I. H. Pardee in the *Archives of Internal Medicine* (February, 1919) to headaches the result of pituitary disorders. Characteristic of this type of headache is its frontal distribution and its intractability to the ordinary remedies. The cause is held to be due to an enlargement of the hypophysis following on a demand made upon it or attributable to disease of the gland. Radiographs made of these cases of pituitary headache show a wide variety of sellæ turcicæ. There may be a very small contracted fossa with the clinoids in apposition or a large fossa with a similar formation of clinoid processes. Or there may be erosion of the posterior clinoids, or even of the anterior processes, with visual changes. Pituitary headache has three characteristics: its location, its duration and persistence, and its relief under specific medication. It is described as being deep in the forehead behind the eyes, with tightness between the temples, and a feeling of pressure or distention. The headache lasts from half an hour to forty-eight hours; there may be exacerbations. At the climax of the headache there may be vomiting followed by relief. It is interesting to note that the ingestion of sugar, for which in these cases there may be a great craving, increases the headache; this is attributable to anomaly of sugar metabolism due to the pituitary disorder, this gland being intimately related to sugar metabolism. Patients subject to these pituitary headaches may show certain general indications of pituitary dystrophies. The hair is apt to be coarse and dark. There may be alterations in the bony framework; eyes too close together or too far apart; prognathism of the lower jaw, or general coarseness of the features. Blood sugar determination and sugar tolerance may show either too high or too low a figure. Marked relief of the headaches is claimed to follow pituitrin medication, 1 gr. three times a day (Armour's tablets). Within a few days there will occur a decrease in the intensity of the headaches. Too long continued pituitrin is inadvisable. Brief reports of seven cases are given in which benefit certainly appeared to follow this treatment.

A NEW RADIOLOGICAL PROCEDURE FOR ABDOMINAL DIAGNOSIS. (*Deutsche med. Wchnschr.*, February 20, 1919; *Med. Rec.*, May 10, 1919, p. 798.)

A. Schmidt backs up the results obtained by Goetze, by gas insufflation of the peritoneum in order to facilitate radiodiagnosis. He maintains that the procedure is inoffensive and may be of the greatest utility. Hepatic and gallbladder affections are those which give the most satisfactory results. Enlarged spleen show up extremely well. The outline of the stomach, brought out by insufflation of the organ, has permitted the writer to make an early diagnosis of carcinoma of the lesser curve in several instances, later on confirmed by operation. The writer offers several drawings made from the most characteristic radiographs taken by him. He likewise studies the field of usefulness of this procedure and states that insufflation of the peritoneal cavity can be combined with the introduction of a laparoscopic tube, thus allowing direct inspection of the viscera which can be compared with the radiological picture of their contours.

RADIOLOGICAL DIAGNOSIS BY MEANS OF PNEUMOPERITONEUM. (*Deutsche med. Wchnschr.*, February 20, 1919; *Med. Rec.*, May 10, 1919. p. 798.)

E. Rautenberg offers a paper on the above subject and puts forward the question of priority. Cases of considerable diagnostic difficulty which have been settled by this procedure are particularly diseases of the liver. The writer also reports some instances of splenic and renal morbid processes which were diagnosticated by this method.

J. Darier. Counter-Indication of Radiotherapy in Certain Cancers of the Skin. (*Bulletin de L'Académie de Médecine*, June, 1918.)

Almost all the cancers of the skin and natural orifices of the body belong to four groups.

1. Tubular or basal cell epithelioma, which is always treated by roentgen rays with good results. This is the common cancer of the face of aged persons, which can last ten or twenty years without extending to the lymph-nodes or causing visceral metastasis. The above type and ulcus rodens disappear after short treatment. The large tumors should be excised and curetted preliminary to treatment.

2. Lobular or spindle cell epithelioma, to which group usually belong cancer of the lips and tongue, of the external genital organs, of the anus, and of cicatrices. This form should never be subjected to radiotherapy, for after a short improvement it activates the cells and renders inoperable a tumor which could have been excised successfully before the treatment.

3. Melanotic sarcoma is ineffectively treated by the roentgen rays. Such treatment is only loss of time, as ultimately the sarcoma should be excised or, even better, destroyed by electrolysis.

4. Secondary carcinoma, which disappears under radiotherapy, but of course this does not affect the primary new growth.

It appears from this that an exact diagnosis of the precise form of cancer should be determined before radiotherapy is applied to a tumor.

Friedrich Winter. Possibility of Immediate Amenorrhea in Cases of Myoma or Other Uterine New Growths. (*Arch. d'Electric Méd.*, July, 1918. *Münchener med. Wchnschr.*, No. 10, March, 1917.)

With the actual methods used in the treatment of uterine fibroma, menstruation ceases in three or four months only. The following technique reduces this to two days, causing an almost instantaneous sterilization.

The machine used is of very high tension. Penetration 41 to 44 cm. (16 to 17½ inches). Milliamperes, 2; target distance, 30 cm. (12 inches). Filter 5 mm. of aluminum and 1 mm. of brass.

The author advises using the filter of higher atomic weight when there is a choice of two equally absorbent substances. Use the large cone, in order to cover the ovaries and all fibromatous tissue with certainty.

Only four fields are irradiated, two abdominal, and two dorsal, each on either side of the median line. Leave one inch space between the fields on the median line, in order to avoid cross fire on the skin.

Each field gets 80X.

The four treatments were given in two days, at the end of the menstrual period.

Twelve cases were treated by the author, of which nine never menstruated again, two flowed once more, and one having a skin reaction (redness) did not return.

Fritz Meyer. Radiotherapy with Hard Rays of Local Hyperhidrosis. (*Berliner klin. Wchnschr.*, Dec. 30, 1918.)

When local hyperhidrosis is treated by medium hard rays, to avoid serious burns the irradiations have to be given at several weeks' interval, during which the sweat glands have time to recuperate and thus annul the temporary result obtained.

Using hard rays, erythema is not attained, as the tolerance of the skin for hard rays is higher and furthermore the hard rays are more advantageous in the treatment of the deeper layers of sweat glands. The increased tolerance of the skin makes it possible so to time the irradiations that the sweat glands cannot recover during the intervals. The author concludes after six years' experience that only strongly filtered hard rays have the power to cure hyperhidrosis.

He uses a tube of 12 Wehnelt and a filter of 4 mm. aluminum. The first treatment he applies a full Sabourand-Noiré dosis and repeats it four times at one week intervals, provided of course that the accumulated rays do not cause a reaction.

It is impossible to lay down definite rules, and experience will teach the radiotherapist whether he can increase the doses and the intervals or decrease the doses and apply them more frequently.

The skin being more delicate in the palm of the hand than on the sole of the foot, more precaution is necessary in its treatment. The areas treated at a time should be small, in order

that the central ray should reach every single gland and cause a uniform action on all the affected surface.

Nogier & Regand. Auto-Immunization of Malignant Tumors Against the *X*-Rays. (*Arch. d'électric. méd.*, July, 1918.)

When a new growth is treated by roentgen rays in successive and spaced doses, its radiosensitiveness does not remain always the same, contrary to the belief of the average roentgenologist.

The radiosensitiveness of a new growth never increases during treatment; it always decreases, causing the same dose to become in time gradually ineffective. This is the impression of the authors, acquired, by the treatment of about a hundred cases of malignant tumors with high doses of strongly filtered roentgen rays.

The diminution of the radiosensitiveness of tumors as a consequence of successive irradiations, differs in various cases. It is hardly noticeable in tumors that disappear under treatment, but remarkably so in inoperable and extensive epitheliomas of the skin of the spindle cell type in many large and rapidly extending cancers of the breast, and in certain sarcomas, especially in myosarcoma.

The authors report a case studied, both clinically and histologically, during the whole course of roentgen ray treatment, upon which they base their opinions.

A child, twelve years old, was treated for an inoperable, ulcerated and large myosarcoma of the temporo-parietal region. In six months she had eleven treatments and seven biopsies.

The first exposure caused a considerable diminution of the tumor and severe general reaction. The second reduced it only slightly and caused no general reaction. The following doses caused but insignificant local reactions. The last treatments were absolutely ineffective. The successive pathologic sections showed an initial and temporary destruction of the neoplastic cells, followed by a reconstruction of the malignant tissue.

The authors think that this auto-immunization is caused by the modification of the humors, due to the absorption of the dead neoplastic tissue.

The variance of the intensity of the phenomenon in diverse tumors seems to be attributable to the difference of the protoplasmic constitution of the cells.

The authors consider it a bad method to divide the doses in the radiotherapy of tumors when it is not an absolute necessity. One should look for effective therapy by giving during a single exposure, or in closely successive sittings the necessary total dose.

The surgeon should be called to remove immediately after irradiation all that is removable of the tumor (even though it be considered inoperable), to prevent the general reaction, and the loss of the radiosensitiveness of what is left of the tumor.

Pierre Lignac. Antiperistalsis of the Colon. (*La Presse médical*, Jan. 30, 1919.)

Antiperistalsis so frequently observed in pathological conditions of the gastrointestinal tract is due to a central or peripheral reflex manifesting itself through the pneumogastric.

The antiperistaltic movements of the colon are physiologic to a certain degree; they can be observed in 50 per cent of the cases under the fluoroscope and can be proved by clinical facts, like the discharge through the cecum of a matter introduced in the distal end of the colon.

The antiperistaltic waves originate midway between the hepatic flexure and the middle of the transverse colon at a point where a ring of tonic constriction appears as soon as the colon becomes dilated by fresh material coming from the small intestine. These waves are not very strong nor constant, and last only about four or five minutes at a rate of five per minute.

These physiologic antiperistaltic waves were observed only in the first part of the colon, where they predominate while they last. J. T. Case of the Battle Creek Sanitarium observed them in the distal end also; but all his cases had pelvic tumors or intestinal new growths, in which event the antiperistaltic wave started from the point of obstruction, playing the rôle of the ring of tonic constriction.

In all cases of ileo-sigmoidostomy he found these antiperistaltic waves moving the feces toward the splenic and hepatic flexures and sometimes as far as the cecum.

The fact that this antiperistalsis has been observed in many cases free from all intestinal lesions, would prove that it must be pathologic.

Jakes considers only the antiperistalsis of the ascending and right half of the transverse colon

as physiologic, and explains its rôle in maintaining matter there during the long hours of absorption.

An exaggerated antiperistalsis of course should always be considered as pathologic, and as indicating a serious intestinal obstruction.

M. Telkes.

Albert Mouchet. Old Fractures of the Semilunar. (*Arch. d'électric. méd.*, Nov. 1918.)

The case described sustained an injury three years previously. There was no swelling or ecchymosis at the time, only a sharp pain with remissions—and diagnosed as due to chronic rheumatism.

Radiography of both hands showed on the injured side:

1. Examination of the height of the wrist, measured in the axis of the third metacarpal.
2. Indistinct interarticular lines.
3. Modification of the form, size and structure of the semilunar, especially in its proximal end, near the radius.

It is flattened in its vertical axis; the radial articular surface instead of being convex is plane and rough.

It is narrower in the transverse axis, as if the horns had been stretched. There are several round spots of absorption in the center, presenting an aspect that many authors regard as a special degeneracy of the semilunar, due to a fibrous and somewhat cystic osteitis.

It is remarkable that the other bones of the carpus show no absorption, so frequently observed in dislocations.

Heinrich Luxembourg. Congenital Absence of Both Patellæ. (*Zeitschrift für Orthopädische Chirurgie*, Oct. 5, 1918, p. 559.)

Total, congenital absence of both patellæ, without any functional disturbance, in an otherwise normally built individual, has been rarely observed so far.

The first record is found in the *London Medical Gazette* of 1833 reporting total absence of both patellæ, without other malformations or functional disturbance as a hereditary and familiar deformity.

Another similar case was described by Wuth (*Archiv. f. Klinische Chirurgie*, 1899, Bd. 58), where the malformation was hereditary only in the male members of the family. These individuals were all good mountain climbers and horseback riders. The only noticeable effect was a peculiar gait; the patient did not step on the entire sole, but put his weight only on the ball of the foot, without the heel touching the ground. The feet were normally built and the gait spastic. The knees were quite flat, with the tuberosities of the tibiæ markedly protruding. The tendons of the quadriceps were attached to these abnormally developed tuberosities of the tibiæ, and would slide between the equally overdeveloped condyles of the femurs, and stood out cordlike, similar to the tendo Achillis, while the joint capsule was in deep grooves on either side. During motion of the joint the tendon could easily be felt sliding in the intercondyloid fossa.

The case observed by Luxembourg is in every way similar to this except that the gait is absolutely normal and the malformation apparently not hereditary. The roentgen ray plate shows not the slightest trace of the patellæ on either side.

The absence of functional disturbance in all these cases suggests that the patella is a more or less superfluous or at least not an indispensable part of the knee joint. The question arises whether it should be considered as a sesamoid developed in the tendon of the quadriceps as a consequence of its friction on the femoral condyles, or, as Wuth thinks, as a former epiphysis of the tibia.

The fact that the operative removal of the patella does not disturb the gait, proves that it is not an essential factor in the functional mechanism of the knee joint.

J. Schütze. A New Radiographic Sign of Gastric Ulcer. (*Berliner klin. Wchnschr.*, Nov. 4, 1918.)

The presence of indentations on the greater curvature has been observed during fluoroscopy and also on sharp radiographs, but has never been interpreted correctly.

The author distinguishes four grades of indentations: shallow, medium, strong and very strong. They were considered as peristaltic, but if they were, they should move from the upper pole of the stomach toward the antrum.

After they appear, they remain fixed, or only move with the peristaltic waves of the gastric body. They are more or less apparent during the examination, showing especially well when

pressure is applied on the point where the patient complains of pain.

By this maneuver the indentations either appear suddenly, or become intensified if previously present.

This symptom is present only when the painful point is on the upper half of the left border of the stomach or the duodenum.

It was found in 60 per cent of the 2,000 cases examined, where the clinical diagnosis was established by good clinicians, to be that of ulcer.

The indentations are attributed to a hypertonic state of the stomach, due to irritation from a gastric or duodenal ulcer, which causes the mucous membrane to plicate transversely. They have the same significance as the deep incisura due to spasm, except that they do not determine the location of the ulcer.

In some instances the indentations appear in cases of cholecystitis and this must be remembered in the differential diagnosis.

The indentations must not be confounded with perigastric adhesions which can be easily eliminated by active or passive movement of the stomach, and by examining the patient at different angles. The latter reveals that sometimes the indentations extend on the posterior surface.

In the presence of indentation one may assume an active ulcerating process of the gastric or duodenal walls.

E. Deglos. Abdominal Pain in Amebic Chronic Enteritis, Clinical and Fluoroscopic Study. (*Arch. d'électric. méd.*, July, 1918.) (*Paris Médical*, July, 1918.)

In certain cases with diarrhea the bismuth passes so rapidly through the digestive tract that it is completely discharged in twenty-four hours.

Usually the stools become creamy or pasty after proper diet and treatment and the bismuth stratifies the large intestine, as shown by fluoroscopy the following day.

In more than fifty per cent of the cases the transverse colon was ptosed, and was found two or three fingers' breadth below the umbilicus. In twenty-five per cent of the cases the transverse colon was on a level with the umbilicus.

These results were obtained especially in the more or less emaciated patients.

Less frequently observed were the cases of angulated, transverse colon, its highest point being at the umbilicus. In one case it was V-shaped, the point of the V attaining the pubis. In two cases out of forty the stomach and colon were ptosed simultaneously. The stomach was atonic, having a large residue one and a half hours after the ingestion of the bismuth. The lowest point of the greater curvature was four fingers' breadth below the umbilicus, the point of the V formed by the colon being behind the pubis.

Functional disturbances are especially intense in cases of marked ptosis of the colon and are probably due to the continual traction of the mesocolon. They consist of uncomfortable pinchings, heavy, bearing down feeling, localized especially in the lower epigastric and umbilical regions.

Sometimes these painful sensations become real pains, accompanied by profound malaise. The moral equilibrium of the patient is disturbed, already deeply affected in long standing cases of chronic amebic enteritis with marked emaciation. In the majority of cases the stomach can be ruled out as the cause of these phenomena, though aerophagia and dyspepsia as a consequence, are quite frequent.

The important factor is the marked colic ptosis and especially that of the transverse colon, favored by the greater or less weakening of the adipo-muscular layers of the abdominal wall.

G. Holzknecht. Therapy of Radiodermitis of the Hands. (*Berliner klin. Wchnschr.*, Dec. 9, 1918.)

Formerly the pre-cancerous alterations of the skin were treated surgically by cauterization or extirpation. But whether treated thus or not, the final result was functional disability due to adhesions and stiffness of the joints.

Radium and roentgen ray therapy succeeded in eliminating the pre-cancerous keratosis or dry desquamation and most epitheliomas by breaking down and discharging the cancerous tissues.

The islands of healthy epithelium join the surrounding healthy skin to form an elastic and only slightly thinner new skin.

This method of treatment allows a restitution at intervals and the reason for not recog-

nizing it sooner was the erroneous belief that the radiodermitis could only be made worse by further exposure and should be carefully shielded from the x-rays.

The radiodermitis is caused by unfiltered rays and must be treated with filtered rays.

The author treated beside his own hands, those of his colleagues, obtaining success in all fifty cases of kerotosis, and of 10 cases of ulcerated epithelioma, only three resisting the treatment.

Radium and roentgen rays were used indifferently, results being the same, but radium proved to be more convenient.

Dosage for roentgen ray: 10 to 12 H. through 4 mm. of aluminum filter, administered in one sitting or broken up into two or three doses of 6 H. with the same filter, at two weeks' interval. The result is the same as in the treatment of skin affections not caused by the roentgen rays.

Dosage for radium: The applied carrier contained 4 mgm. of radium metal to 1 cm. of surface. The filter consisted of 0.2 mm. of silver. Further filtration was obtained by 1 mm. of aluminum, to 1 mm. of brass, and a thin layer of cotton. The irradiation lasted from one or one and a half hours to eight hours.

Levy-Dorn, Mal. Contribution to the X-Ray Study of Ossifications Found in the Soft Tissues. (*Berliner klin. Wchnschr.*, Sept., 1918.)

The author reports the case of a fifteen-year old boy, presenting a cold abscess the size of a fist below the middle of the inguinal arch, on the internal and anterior side of the upper part of the left thigh. The hip joint was freely movable.

The roentgen ray plate showed on both sides a shadow about the size of a prune in the soft parts, on the inner side of the major trochanter.

As there is no record of bony structure lying with its longitudinal axis parallel to the femur he concluded that the shadows could be nothing but the calcified superficial inguinal glands. This symmetric, bilateral calcification (3 x 2½ cm.) is quite infrequent and noteworthy.

In another case, he found a similar but smaller shadow in the roentgenogram of a fracture of the neck of the femur, where it might have been taken for a bone splinter had it not been isolated and too far away from the line of fracture (2 cm. below the minor trochanter).

He also found signs of ossification in a case of beginning tuberculous hip disease in an elderly woman, but on the unaffected side.

He concludes that a single, calcareous body of various sizes, in the vicinity of the minor trochanter, found either on the diseases or on the opposite side, sometimes bilateral and symmetric, occurring indifferently in young or old, man or woman, should be considered as a calcified lymph gland, and not confounded with foreign bodies, bone splinter or the shadow of myositis ossificans. As its presence implies the existence of tuberculosis in the body, it can aid in the early diagnosis of tuberculous hip disease.

Morcan. Radiotherapy of Large, Malarial Spleen. Regression of a Case of Extremely Marked Splenomegaly After One Dose of X-ray. (*Arch. d'électric. méd.*, November, 1918.)

The case is that of severe malaria, with large spleen and marked anemia, but no malarial parasites in the blood.

One treatment produced a violent reaction, with hypercongestion, and started an attack of malaria with reappearance of the hematozoa in the peripheral blood.

The spleen regressed after that quite rapidly, till it attained its normal size, while the quinine and arsenics administered made the parasite disappear from the blood. General condition improved notably.

Gray, Alfred L., M.D., Richmond, Va. Further Report on the Treatment of Non-Malignant Laryngeal Vegetations by the Roentgen Rays. *Virginia Medical Monthly*, Vol. 46, No. 2.

Two cases were previously reported, both of which recovered. The author now refers three more cases, the last of which was a man forty-five years of age who has been free of all evidence of trouble for nearly two years. The last examination of his larynx was nine months ago. The author states that without exception each patient has been completely cured as shown by the laryngoscopic examination, or else the recovery was satisfactory to the patient's family and further treatment was not continued.

HAZEN, H. H., M.D., Washington, D. C. The Roentgen Ray Treatment of Tinea Tonsurans. *Jour. of Cutaneous Dis.*, Vol. 37, No. 5.

The proper use of the roentgen ray will cure 99 per cent of the cases and will do no harm if properly employed. The object of the roentgen ray is not to kill the organisms but to produce a defluvium; this removes the majority of the spores which are contained in the hairs, reduces the food supply of the parasite and the remainder can be cured by antiparasitic remedies, inasmuch as such remedies can gain access to the follicles once they are empty.

The results of the treatments are as follows:

"To date I have treated 225 cases of tinea tonsurans by this method, the diagnosis of all doubtful cases having been confirmed by the microscope. The majority of these cases were sent by the Board of Children's Guardians, and were from the various homes supervised by this board. In seventeen instances but a portion of the scalp was epilated, and in fourteen of these cases it was later found necessary to remove all of the hair inasmuch as other patches of the disease developed. In one private case the mother refused to have the whole scalp epilated, and thirty-four different treatments were given to various sized patches before final recovery took place. I should not treat a case in such a way again. In only one instance was there a recurrence, although there were six cases of new infection. In the one case of recurrence the hair was again epilated exactly three months from the date of the original treatment with perfect results. There were but two untoward results due to treatment, both of which should have been avoided. In one instance the clock by which the timing was done stopped during the treatment, the result being an over-exposure and permanent alopecia. In another instance the child moved during treatment and a slight erythema resulted from the overlapping of the fields of exposure with a resulting erythema and a slight thinning in the returning hair. In the children from one home, too strong an ammoniated mercury ointment was used after radiation, and there was a resultant crop of boils, but no other trouble. The hair does not always return the same color. In a private case with beautiful red hair the new hair was brown. At times the texture of the new hair is not the same as that of the old, an additional argument against partial epilation. . . .

"There appears to be no convincing report of any brain injury resulting from such roentgen ray treatment."

SIMPSON, CLARENCE O., M.D., D.D.S., St. Louis, Mo. Cooperation of the Orthodontist and the Radiodontist. *Internat. Jour. of Orthodontia and Oral Surg.* Vol. 5, No. 5.

After describing the evolution of orthodontia he states that the maximum efficiency in dentistry cannot be attained by one who attempts all types of operations. He uses the term radiodontia, which he describes as follows:

"The term radiodontia, being of comparatively recent adoption, may require some explanation. It is defined as the art and science of making and interpreting radiographs of the teeth and adjacent structures. Etymologically it is vulnerable to the criticism of having its origin from both Latin and Greek, but it euphoniously combines radio and odontia and greatly simplifies the term of dental radiographer and diagnostician, and conforms to the accepted terminology of orthodontia, periodontia, and exodontia. It includes far more than the mechanical procedure of radiography, in that the intelligent examination and interpretation requires professional education, clinical experience, and special study. The qualifications of a competent radiodontist are:

"A practical knowledge of electricity, and sufficient mechanical ability to manipulate and maintain radiographic apparatus at its maximum efficiency.

"Sufficient experience in photographic technic to secure the best results in the dark room work.

"A professional education which includes more pathology, histology, and bacteriology than in the past has been provided in the dental curriculum.

"Clinical experience derived from the general practice of dentistry, the longer and more creditable the better, since too many men begin the practice of a specialty without the advantages of experience in general practice, or after having been unsuccessful from incompetency.

"An extensive study of radiographic films and plates to develop proficiency in recognizing normal structures and detecting errors in technic and variations from the normal.

"A sixth sense which may be called a histopathologic intuition to reason from cause to effect and conversely.

"A broad professional spirit with the greatest consideration for the welfare of the patient, assistance to the dentist, and cooperation with the physician.

"An absorbing interest and enthusiasm for the work with unlimited confidence in the value and future development of the practice."

He then states that one with the above qualifications should be able to render valuable service to his confrères.

BOOK REVIEWS

RADIO-DIAGNOSIS OF PLEURO-PULMONARY AFFECTIONS. By F. Barjon. Translated by James A. Honeij, M.D., Assistant Professor of Medicine in charge of Radiography, Yale Medical School. 183 pages; 81 illustrations. Price $2.50. Yale University Press, New York.

This book can be recommended to every roentgenologist, and no one can fail to gain some useful knowledge from reading it. The author is to be commended for taking up one important aspect of roentgenologic diagnosis and writing it up in detail from a broad experience along that particular line, rather than attempting to compile a book covering the entire subject of roentgenology in a more or less elementary manner. One may object to the style of the text, but this can readily be overlooked when one considers that the ideas of the author have probably been followed in a more or less literal manner by the translator.

This review is intended particularly for roentgenologists, but the book is also to be recommended to the internist and surgeon, for it is concise and reliable, and one well calculated to keep those interested in roentgen diagnosis, but not engaged in it, in touch with what should be expected from this method of examination.

The first section describes the method of screen examinations of the chest. It is short and concise, as it should be. The second section includes the diagnosis of all conditions of the pleura and appeals to one as probably the most important and interesting part. It is certainly well worth careful study.

The third part is arranged to include conditions of the bronchi and peribronchial tissues and the tracheobronchial lymph nodes. The conditions described are foreign bodies, bronchiectasis, stenosis, bronchial irritation, tracheobronchial adenopathies, including malignancy, and the thymus.

The fourth section deals with pathology of the lungs, and the following conditions are included: congestion, edema, pneumonia, abscess, gangrene, emphysema, atelectasis, tuberculosis, neoplasms, and hydatid and dermoid cysts. The chapter on tuberculosis is a variation on what has been so familiar to us in American literature for the past few years. The subject is discussed in quite a different manner, but most of the author's conclusions are similar to the views of the most conservative American authorities on the subject of the roentgen diagnosis of pulmonary tuberculosis.

The final section is devoted to penetrating wounds of the chest by war projectiles. This contains nothing new to those who have had training in localization methods or who have kept in touch with military roentgenology. A final note by Major J. S. Shearer indicates that American roentgenologists were familiar with the subject at the time of the translation of the book.

H. K. PANCOAST.

ROENTGENOTHERAPY. By Albert Franklin Tyler, B.Sc., M.D., Professor of Clinical Roentgenology, John A. Creighton Medical College; Roentgenologist St. Joseph's Hospital, Bishop Clarkson Memorial Hospital, Ford Hospital, Immanuel Hospital, Douglas County Hospital, and Lord Lister Hospital, Omaha, Neb. Member American Roentgen Ray Society; etc. 162 pages, 111 illustrations. Price $2.50. C. V. Mosby Co., St. Louis, 1918.

This little book is intended as a reference and text book for students in roentgenology. It is naturally elementary, but is well arranged and would seem capable of serving its purpose in a very satisfactory manner. Dr. Tyler is well known to American roentgenologists and it is to be regretted that he could not have seen fit to go into the subject more deeply and make it a comprehensive reference book for everyone interested in the subject. The first chapter gives the modern terminology now in use in this country. The second chapter describes the apparatus required for modern roentgen therapy and the methods of measuring dosage. The third and fourth chapters deal with the superficial and deep conditions in which roentgen therapy is applicable. The general method of dealing with each condition is stated. The remainder of the book is taken up with a description of representative cases that have received treatment. The illustrations are excellent.

Roentgen Diagnosis of Diseases of the Head. By Dr. Arthur Schüller, Head of the Clinic for Nervous Diseases, Franz Joseph Ambulatorium, Vienna. Authorized translation by Fred F. Stocking, M.D., M.R.C., with Foreword by Ernest Sachs, M.D., Associate Professor of Surgery, Washington University. Approved for publication by the Surgeon General, U. S. Army. 305 pages, 97 illustrations. Price $4.00. C. V. Mosby Co., St. Louis, 1918.

Most American roentgenologists are familiar with Dr. Schüller's book, which made its appearance a short time before the onset of the recent world conflict. Its publication gave him the reputation of being probably the greatest authority on the roentgen diagnosis of various conditions of the head. As this is doubtless the most comprehensive book ever published on roentgenology of the head, it needs no further recognition than this. To those familiar with the subject it is authoritative, and those who have known Schüller have recognized him as a master of his subject. We should be grateful to the translator for his efforts to present the text in English and in so admirable a manner. As a former student under Schüller he was well fitted for the task. While the book deals particularly with the roentgenologic aspect of the subject, it will certainly appeal to one from the general diagnostic standpoint. The neurologist as well as the roentgenologist should be familiar with its contents.

The first chapter deals with the morphology and development of the skull in different races and at different ages. The second includes a discussion of anomalies in size, shape and contour due to disturbances or abnormalities in skeletal development and growth, and the effects of external agencies. The subject is discussed in a very thorough and comprehensive manner, based upon an unusually wide experience. This chapter also deals with changes in consequence of systemic disorders—cretinism, achondroplasia, Paget's disease, and many rarer affections; and also inflammatory conditions—osteomyelitis, syphilis, tuberculosis and actinomycosis, and tumors of the bones of the skull. Injuries are included. The third chapter deals with pathological conditions within the skull which can be demonstrated directly by the roentgenogram. The author aptly calls attention to the fact that one can show no changes in brain structure except calcification. Otherwise, lesions must belong to the pressure group, cause bone destruction or bone formation, or invade the accessory sinuses. A very thorough discussion is given to sellar changes and the general changes resulting from intracranial pressure. It is very disappointing to find that conditions of the eye, ear, accessory sinuses and teeth have received bare mention in an appendix, as a sort of afterthought.

H. K. Pancoast.

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BONE AND JOINT LESIONS OF YAWS WITH X-RAY FINDINGS IN TWENTY CASES * †

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WHILE attending the clinical course of instruction of the graduate school of tropical medicine and public health of the College of Medicine and Surgery, University of the Philippines, during the 1916 session, my attention was directed to the study of the painful bone and joint involvements occurring in some cases of yaws. This complaint prevailed among a great number of patients that were subsequently seen in the barrios of Las Piñas and Parañaque.

Through the courtesies of Doctors Luis Guerrero, Domingo, and Argüelles arrangements were perfected by which a group of one hundred cases of yaws was collected for study.

My work was confined to the cases of suffering from bone or joint lesions. Any one who has attempted such a work among Filipinos realizes that there are certain limitations in obtaining reliable information that might materially affect one's conclusions. The first month of the work was spent in gaining the confidence of the patients by frequent visits to their homes, by furnishing free medicine, and by assuring them of no inconvenience and of a cure of the disease.

The diagnoses of these cases were made by the histories, by the clinical symptoms and manifestations, and by the demonstration of *Treponema pertenue* under the dark-field microscope in the cases where an open lesion was present, and by a careful history of those without open lesions, so as to remove any doubt as to the diagnosis.

Twenty per cent of the cases of this group of patients, as they presented themselves for treatment, suffered from bone or joint lesions. These patients were persuaded to come to the Department Hospital, Manila, for *x*-ray examinations and treatment. A roentgenological survey of all the bones of the body was made of each case, regardless of whether or not the patient complained of pain in the part *x*-rayed. Subsequent roentgen ray plates were made, in order to follow the progress of the lesions under treatment.

In the majority of cases the lesions show as rarefied areas, irregularly oval or elliptical in shape with the long axis parallel to that of the bone in which the lesions are located. The size varies from the smallest discernible area to one that is two or three centimeters in length. The rarefication presents moderately well-de-

* Read, by permission of the Chief Surgeon, Philippine Department, before the Manila Medical Society, Manila, and authority granted for publication. † Reprinted from *The Philippine Journal of Science*, Vol. XIII, No. 2, Sec. B, Tropical Medicine, March, 1918. Authority to publish granted by the Board of Publication, Surgeon General's Office, Washington, D. C.

fined borders separating it from the unaffected bone and varies in translucency from the slightest differentiation of unnatural transparency to one simulating a perforation. Most of the lesions appear to originate in the interior of the bone, while a number can be seen as small excavations on its outer surface. When the lesion is on the surface of the bone, the periosteum is usually destroyed, but occasionally the cortex shows thickening, and the periosteum is separated from the bone. In two cases of this series there is a general thinning of the cortex of the bone and a loss of the cancellous-tissue appearance. About two per cent of the cases show a nodular type of lesion, evidenced by swelling over the surface of the bone, with a localized thickening of the cortex, which sooner or later in the course of the disease shows rarefication in its center.

In the chronic lesions marked irregularity of the bony outline is evident, and the picture characteristic of the earlier lesions is more or less lost. The bone as a whole becomes deformed, and the growth of the bone is interfered with both in length and breadth. This dwarflike picture is most frequently noticed in the cases showing the lesions in the epiphyses. Within the joints the destruction is most frequently seen on the parts of the articular surfaces most exposed to trauma, as oval or irregularly shaped excavations, making the outline of the articular surface rough and uneven. It is concluded from this series of cases that the joint pains complained of are due in most part to the presence of the lesions on the articular surfaces.

With the exception of the 2 per cent of cases showing as a swelling over the surface of the bone, the roentgen ray picture is different from the bone lesion of syphilis, in that: (1) The periosteal proliferation is absent, and (2) the thickening of the cortex of the bone is absent. Also, in the 2 per cent of cases where thickening of the cortex is present, the thickening remains localized, does not tend to extend along the whole length of the bone, and sooner or later shows rarefication in the center of the lesion.

The bone lesion of yaws may simulate (1) tuberculous or septic central abscess, (2) gumma, (3) hydatic cyst, (4) benign cyst, (5) fibrous osteitis, (6) enchondroma, (7) endothelioma, (8) secondary carcinoma, (9) myeloma, and (10) sarcoma. The differential diagnosis can be made only by combining the radiographic appearances with all clinical data, including the history, physical signs, and evidence of disease or tumor in other parts of the body.

Summarizing the findings in Table I, it is seen that in 20 cases of bone lesion in yaws:

1. The shaft of the bone is the most frequent location of the lesion and shows involvement in 80 per cent of the cases.
2. The epiphyses or articular surfaces are involved in 20 per cent of the cases.
3. The tibia is the bone most frequently involved (40 per cent of this series).
4. The order of frequency of occurrence of the lesions in the other bones is as follows:
   - (a) Tarsal bones, 40 per cent (75 per cent of these lesions occur in the os calcis).
   - (b) Fibula, 35 per cent.
   - (c) Phalanges of feet and hands, each 30 per cent.
   - (d) Metatarsal bones, metacarpal bones, and radius, each 20 per cent.
   - (e) Patella and humerus, each 15 per cent.
   - (f) Femur and ulna, each 10 per cent.
   - (g) Carpal bones, ribs, sternum, and pelvic bones, each 5 per cent.
   - (h) In the bones not mentioned no lesions were found.
5. There is no constant relation of the location of the external lesion to the bone lesion.
6. The order of frequency of occurrence of the lesions in the joints is as follows: Knee, finger, ankle, and elbow.
7. The lesions are multiple in 75 per cent of the cases, the greatest number being one hundred thirteen.
8. The time between the appearance of the primary lesion and bone lesions varies

from six months to nine years, with an average of two and eight-tenths years. In this series 45 per cent of the cases showed bone lesions one year; 15 per cent, two years; 5 per cent, three years; 10 per cent, four years; 5 per cent, five years; 15 per cent, six years; and 5 per cent, nine years after the appearance of the mother yaw.

Fifty per cent of the cases of this series were under fifteen years of age; 75 per cent, under twenty years of age; and 90 per cent, under thirty years of age.

In the observations made by McCarthy,[17] in 1906, on the prevalence of tertiary lesions in defined localities and among certain classes of people, he gives the frequency of their occurrence and their description as follows:

"1. Chronic thickening of the skin on the palmar surface of the hands and soles of the feet.—The fissures in cases extended only partially through the skin, were painless and dry, and caused no further discomfort than a feeling of uncomfortable roughness over the affected parts.

Table 1.—Site of lesion, bones involved, interval between appearance of primary and bone lesions, and ages of patients in twenty cases of yaws[a]

	Case No																				
	1	2	3	4	5	6	7	8	9	10	11	12	20	21	22	23	24	25	30	31	Total
Phalanges of hand	1		1			1		1										1		1	6
Metacarpus	1		1					1							1						4
Carpus			1																		1
Ulna			1					1													2
Radius	1		1				1	1													4
Humerus			1					1											1		3
Scapula	1																				1
Sternum																1					1
Clavicle																					0
Ribs			1																		1
Vertebra																					0
Pelvic bones			1																		1
Femur			1					1													2
Tibia	1		1		1	1		1				1		1	1						8
Fibula	1	1	1					1						1	1			1			7
Patella	1		1					1													3
Tarsus			1												1						2
Os calcis		1			1				1				1		1		1				6
Metatarsus	1		1	1								1									4
Phalanges of feet	1		1				1	1		1	1										6
Shaft	1	1	1	1	1	1	1	1		1	1	1		1	1			1	1	1	16
Epiphyses	1		1					1							1						4
Total lesions	19	5	52	2	2	10	8	113	1	1	2	2	2	6	18	1	1	2	1	2	4
Appearance of primary lesion	1909	1915	1911	1915	1914	1915	1911	1916	1911	1915	1909	1916	1912	1912	1905	1905	1910	1913	1910	1915	
Appearance of bone lesion	1910	1916	1912	1916	1916	1916	1912	1916	1914	1917	1915	1917	1916	1917	1914	1907	1916	1917	1916	1916	
Years between appearance of primary and bone lesions	1	1	1	1	2	1	1	½	3	2	6	1	4	5	9	2	6	4	6	1	[b]2.8
Age .... years	7	10	15	7	23	50	28	27	16	7	36	7	15	17	14	18	14	5	19	8	

[a] Each individual bone has been tabulated but once under its respective heading, whether or not the lesion appeared in the same bone on the opposite side of the body.
[b] Average of years between appearance of primary and bone lesions.

"In others, the cracks extended down to the muscular layer, exuding a sero-purulent discharge and were extremely tender on pressure. The sensibility of the surface of these parts is greatly diminished.

"2. Chronic indolent ulceration of various parts of the body.—These ulcers varied in size from small ones to those of the size of a hand or larger. When not associated with periostitis, the ulcers are painless and heal slowly. When multiple, the general health is greatly impaired, anemia and emaciation set in, and chronic invalidism is caused. Ankylosis caused by cicatricial contraction of extensive ulceration on the flexer aspect of joints has been observed in several cases.

"3. Periostitis and osteitis are other sequelæ frequently seen.—The shaft of the tibia, radius, and ulna are the usual sites of these complications. A swelling resembling a syphilitic node, appears over the shaft of the bones involving all the tissues covering it. This is at first painless. As the growth enlarges, the bones become thickened and the surface of the skin is glazed and purplish, and pain on pressure is present. The skin in time breaks down and troublesome ulceration results. When joints are affected, usually the knee, finger, and elbow-joints, with this variety of the disease, ankylosis results.

"Necrosis of the nasal and palate bones resembling the syphilitic affection of this nature, have been seen in several cases.

"4. Cartilaginous tumors on the elbow and knee joints have been observed in nine cases. These tumors were painless, and caused no discomfort except for their size and position. They were ascribed by the sufferers to an antecedent attack of yaws."

Rat,[29] Daniels,[13] and Boissière reported cases with destruction of the nose and palate and discussed the probability of these lesions being due to yaws. Boissière also noted tibial involvement, joint swelling, and dactylitis.

Castellani[9] cites the sequelæ of two cases as follows:

"CASE 1. Young Singhalese girl of about fourteen years of age. No history of syphilis either congenital or contracted: five years of age suffered, together with all other members of the family, from yaws and was treated in a Government Hospital from which she was discharged cured a few months later. She remained so till four months ago when she noticed a slight indolent swelling on the right leg which increased in size and finally broke out leaving a rather large ulceration. Two months later when I examined her, several ulcers were present in both legs, of irregular shape, thin margins, rather deep and without much secretion; the left tibia was arching forward; moreover on one of the ribs an indolent gummatous-like swelling was present. In the secretions of the ulcers no spirochætes were found. The girl has been treated with potassium iodide and the ulcers have healed, leaving large whitish irregular scars.

"CASE 2. Singhalese girl about eleven years of age. Sister of the previous patient. No history of syphilis: genital organs intact. Five years ago she suffered from yaws at the same time as her sister. She recovered and remained in good health until three months ago when an ulcerative process developed on the soft palate which at the time I examined her, had already destroyed the uvula. The patient presented the thickening of the metacarpal bones and phalanges which had caused a certain distortion of the right hand. The potassium iodide treatment was begun two months ago, and the patient is rapidly improving, the ulcerative process of the palate being already arrested and healed. No spirochætes were found in the ulcer."

Ashburn and Craig[1] cite experiments produced by Neisser, Baermann, and Halberstädter[18] where three monkeys (*Macacus cynomolgus*) were inoculated subcutaneously with the bone marrow from a monkey (*Macacus cynomolgus*) infected with frambesia, with the result that one of the three inoculated with bone marrow developed the disease after an incubation period of forty-four days.

It is very evident that the majority of

bone and joint lesions of yaws is the result of a general infection. The explanation of the peculiar selective bone manifestations in some cases may be similar to that of the various manifestations of syphilis due to variations in strains.[15, 21, 22, 23, 31]. The experiments attempted by me to reproduce the bone lesions in animals have been been so far unsuccessful.

In the treatment of these cases the Castellani[5, 6] mixture was used according to directions, except that a small amount of glycerin was added to improve the taste and so get the patients to take the treatment consistently.

TABLE II.—*Castellani's mixture in the treatment of yaws*

	Quantity.
Tartar emetic............grains	1
Sodium salicylate............do	10
Potassium iodide............drachm	1
Sodium bicarbonate............grains	15
Water q. s............ounce	1

Salvarsan was used in three of the cases, two of which received 0.4 gram, while the third received 0.2 gram, given intravenously.

In the observation of these cases, over a period of five months, the effect of the treatment on the regeneration of the bone at the sites of the bone lesions was studied by radiographs taken at monthly intervals as nearly as was practicable. In every case the clinical and subjective symptoms disappeared long before the radiographs showed the bone lesions to have disappeared.

The histories of the most important cases are as follows:

CASE I.—B. U., Filipino, eight years old. The primary lesion was on the right leg, while the patient was still a nursing baby. The secondary lesions appeared soon afterward and were most manifest on the hands and about the mouth. The secondary lesions gradually disappeared without treatment, but the mother yaw remained for over a year. Five years later the proximal phalanx of the index finger of the right hand became swollen and enlarged. Soon the adjacent fingers became similarly involved, but the patient stated that the fingers were not painful. On

PLATE I

FIG. 1. LESIONS IN PATELLA AND TIBIA. CASE 3.
FIG. 2. LESIONS IN OS CALCIS. CASE 2.

February 10, 1917, the roentgen ray pictures showed a total of nineteen bone lesions including those on the articular surfaces. The Castellani treatment was

given in one-half the adult dose, but the patient soon complained of gastric disturbance and headache. The amount was then reduced to one-fourth the adult dose. After five months the bone lesions showed definite improvement, and considerable regeneration of the bones had taken place.

PLATE II

FIG. 1. JOINT LESIONS. CASE 1.
FIG. 2. ANKYLOSIS, FOLLOWING JOINT LESION. CASE 3.

CASE II.—M. S., Filipina, ten years old. The primary lesion was on the left leg in 1915. The secondary eruption, which appeared six weeks later, gradually disappeared after the third month without treatment. In August, 1916, she complained of pain in the left leg, which condition persisted until she was seen in February, 1917. The roentgen ray plates at this time showed one lesion in the lower part of the tibia and four in the os calcis. Further observation of this case was not possible.

CASE III.—P. G., Filipina, fifteen years old. The primary lesion appeared on the left leg in October, 1911. This lesion improved without treatment, but did not completely heal. The secondary eruption appeared three weeks later and was most marked upon the feet. Other lesions were scattered about the face, anus, and vulva. After one and one-half years the eruption had disappeared except from the lower extremities. It was elicited that severe rheumatoid pains involving all the joints developed about six months after the appearance of the primary lesion and persisted during the next four years. During this period of her illness the soft tissues of the middle finger of her left hand became contracted and the finger could not be extended, the external lesions had become large ulcers, and the bone and joints of both extremities were so painful that she suffered constantly. In 1915 she was admitted to a hospital in Manila in a helpless condition. During the two years she remained there the condition was but little relieved, and upon returning to her home she became entirely helpless from the pain she suffered. The ulcerations were deep and painful and emitted a foul odor of decomposition.

When the patient was seen in February, 1917, she weighed 22.68 kilograms (50 pounds) and was 1.1 meters (3.5 feet) in height. There were large areas of scar tissue and of ulceration involving the greater part of the lower extremities. She was badly emaciated and anæmic and cried continuously when she attempted to walk or move about. A roentgen ray survey of all the bones of her body was made and a total of 52 bone lesions, including those

on the articular surfaces, was found. She was given the Castellani treatment in full doses three times a day, one-half hour before meals. She continued to take the treatment regularly for the next two months, but still suffered from the bone and joint pains. The roentgen ray plates made at this time showed very slight improvement of the bone and joint lesions. She was then given 0.4 gram of salvarsan intravenously. The relief of the symptoms was as marvelous as in the cases cited by Strong in his work on cutaneous yaws,[33] in 1910, and the change in the bone and joint lesions became manifest radiographically within a month's time. No more salvarsan was given, but the Castellani treatment was continued until July 1, 1917, when the roentgen ray plates showed almost complete regeneration of the bone where the lesions had been. At first the lesions showed a lessened degree of translucency, then a diminution in size, and later a return of the cancellous-tissue appearance.

During the treatment she had persistent thirst, some salivation, and nasal catarrh, but no gastric disturbances.

CASE IV.—D. S., Filipino, seven years old. The primary lesion was on the neck, in June, 1915. One month later the mother yaw began to disappear, and a general secondary eruption followed after a short febrile period. As the secondary eruption disappeared, rheumatoid pains appeared in several of the joints.

When the case was first seen on February 10, 1917, the right arm was flexed at the elbow and made useless by a contracture on the anterior surface of the joint. This contracture had persisted for the past year. At this time the Castellani treatment was started in one-half the adult dose, and by the end of the second week the contracture had disappeared, but the painful bone lesions persisted for some time. Roentgenograms after full five months' treatment showed a marked improvement of the lesions, but regeneration was not complete. While taking the treatment, the patient vomited on several occasions, showed marked depression on the fifth day, became salivated, and had severe catarrhal symptoms.

PLATE III

FIG. 1. FLEXOR CONTRACTURE AND MULTIPLE BONE LESIONS. CASE 3.
FIG. 2. FIVE MONTHS LATER. CASE 3.

CASE V.—A. G., Filipino, twenty-six years old. The primary lesion appeared in August, 1914. This lesion persisted about one month. One month later the secondary eruption appeared about the axilla, elbows, mouth, anus, and prepuce, and these lesions disappeared without treatment, but soon afterward contractures of the extremities and severe rheumatoid pains in the feet developed. These conditions existed for about two years, and at the time I first saw him, he was able to get around and do light work. The roentgen ray plates showed bone lesions in the left os calcis, on the articular surface of the upper extremity of the left tibia, and on the

phalanges of the hands. The patient was started on the Castellani treatment February 10, 1917, and by February 25 marked improvement was evident. To hasten the recovery of the case, 0.2 gram of salvarsan was given intravenously, but the case did not return subsequently and could not be followed.

CASE VI.—A. S., Filipino, sixty years old. The primary lesion appeared on the right leg on June 5, 1915. Two months later he developed the secondary eruption and a varicose condition of the veins of the middle finger of the right hand. The finger became twice its normal size and was spindle-shaped, boggy, and worm-like to the touch, but was not painful. (It is questionable if this condition had any relation to the yaws.) He complained of pain in the tibia and femur, which had existed for one year at the time he was first seen on February 10, 1917. The roentgenograms showed a total of ten lesions. Those of the phalanges of the hands showed a marked narrowing of the cortex of the bones, while the one on the upper end of the tibia was on the surface of the bone and was excavated in character. He was given the Castellani treatment, which he took regularly, and although he stated that his pains had left him, the lesions were still evident by the roentgen ray after five months' treatment.

CASE VII.—C. R., Filipino, twenty-eight years old. The primary lesion was on the right knee in September, 1911. Two months later the secondary eruption appeared, after which there were violent rheumatoid pains in the phalanges on the feet and hands. One year after the initial lesion the distal phalanges were swollen and knoblike. On February 10, 1917, the roentgen ray showed rarefication of the terminal phalanges of the toes and thinning of the cortex of the phalanges of the hands. He was given the Castellani treatment, but he disliked the medicine, and the case could not be followed.

CASE VIII.—F. P. (As this case is one from which the description of the bone lesion has been made, a more detailed history will be given as prepared through the kindness of Doctor Domingo, senior house physician at the Philippine General

PLATE IV. CASE 8.

FIG. 1. MOTHER LESION, BEFORE TREATMENT.
FIG. 2. MOTHER LESION, AFTER TREATMENT.
FIG. 3. SECONDARY ERUPTION, BEFORE TREATMENT.
FIG. 4. SECONDARY ERUPTION, AFTER TREATMENT.

Hospital.) General data: Filipina, twenty-seven years old. Married, housewife by occupation. Born in Parañaque, Rizal, and has lived there ever since. She came to the Philippine General Hospital during the latter part of January, 1917, complaining of pain in the bones and joints, although she also presented several sores on the face, scalp, and neck. Smokes five to seven cigarettes each day.

Family History.—No history of tuberculosis or syphilis. Father and mother liv-

ing and well. Has seven brothers, one of whom is in the United States, while the rest are in Parañaque. All are living and well, except one, who has the same external lesions as the patient.

Personal History.—The patient had her first menses at the age of thirteen and married when fifteen years of age. She has had four children, one of whom died of *suba** one has *bubas*† at present, and the other two are well. Has not had any miscarriages. Her husband is living and well and has no history of venereal disease. The youngest child is still nursing the mother.

Previous Illness.—None relevant to the present condition.

Present Complaint.—Primary lesion started in August, 1916, as a small papule on the anterior aspect of the left ankle. It was neither painful nor itchy. It continued to grow, and about January 16, 1917, when the case was seen with Doctor Guerrero at the Philippine General Hospital, the lesion was about 2 centimeters in diameter, in the form of a large round ulcer with more or less irregular edges and elevated granulating surface, from which an abundance of serum could be expressed. Examination of this serum showed twenty or more *Treponema pertenue* to every field. One cubic centimeter of this serum was taken from this lesion for inoculation of animals. In the latter part of October, 1916, the secondary eruption appeared on the face, scalp, neck, abdomen, and vulva. When the patient was admitted to the hospital, these lesions were nearly all circular in outline, although a few of the lesions on the face were more or less elliptical. They were raised from the surface and covered by a thick, hard yellowish crust. Removal of the crust left a raw, granulating surface. Some of the lesions of the face and abdomen were flattened out and deeply pigmented at the edges.

The pains in the bones and joints started in December, 1916, and gradually became more and more intense, until she could hardly walk. The phalangeal joints of the fingers were swollen and painful. No other joints were swollen, but pressure on the bones and other joints produced intense pain. There was no fever nor headache.

Roentgenograms of her hands were at this time made by Doctors Fernandez and Argüelles, and an abundance of lesions were present in all the bones. The Castellani treatment was given to her by Doctor Guerrero until she left the hospital. I saw the case again on February 25, 1917. The external lesions were healed, but she still

PLATE V.

FIG. 1. NO BONE REGENERATION AFTER SIX WEEKS OF CASTELLANI TREATMENT. CASE 8.

FIG. 2. REGENERATION OF BONE OF THE SAME CASE AFTER SALVARSAN. CASE 8.

*Infantile beriberi. †Yaws.

complained of pains in the bones. She had continued to take the Castellani treatment rather irregularly. She was induced to take her medicine as prescribed until March 2, when it was learned that she refused to continue with the treatment. Nevertheless she readily submitted to treatment by salvarsan, and 0.4 gram was given intravenously on March 4. The roentgen ray plates taken on the same day showed no changes from those taken in February at the hospital. There was a total of 113 lesions. By the end of the second week, after this injection, the patient was entirely relieved of pain. In April the roentgen ray plate showed a very definite regeneration of the bone at the sites of the lesions. By the early part of July only a few places could be recognized where the lesions had existed.

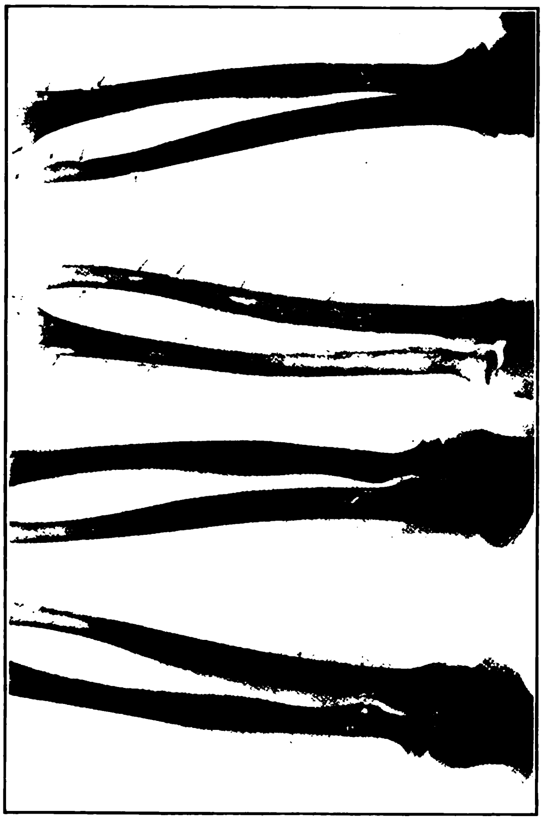

PLATE VI.
FIG. 1. TYPICAL BONE LESIONS OF YAWS. CASE 8.
FIG. 2. REGENERATION OF BONES AT SITES OF LESIONS. CASE 8. SAME AS ABOVE.

CASE IX.—R. F., Filipino, sixteen years old. The primary lesion occurred on the right knee in September, 1911. The secondary eruption appeared one month later and gradually disappeared without treatment. He stated that in 1914 he suffered with pains in the joints involving the shoulders, elbows, hips and knees, and the phalangeal joints of the fingers and toes. At the time he was seen, February 10, 1917, he was entirely well, except that his right heel was painful. The roentgen ray plates showed only one lesion in the os calcis. The case could not be followed.

PLATE VII.
FIG. 1. CHRONIC BONE AND JOINT LESIONS WITH DEFORMITY. CASE 1.
FIG. 2. CASE 1 FIVE MONTHS AFTER TREATMENT BY THE CASTELLANI MIXTURE.
FIG. 3. CHRONIC BONE LESIONS WITH DEFORMITY. CASE FROM DOCTORS FERNANDEZ AND ARGÜELLES.

CASE XXII.—R. C., Filipino, fifteen years old. The primary lesion was on the left knee in 1905. The secondary lesions appeared a few months later and persisted until 1913. No treatment was given. The secondary lesions gradually disappeared, but the mother yaw did not heal. From this time the bones and joints of the lower extremities became painful, and by August, 1916, he was unable to walk. He was in this helpless condition when I saw him on February 25, 1917. The roentgen ray plates showed a total of 18 lesions, involving the os calcis, scaphoid, tibia, fibula, and the articular surfaces of the tibia and femur on the right side and the os calcis, tibia, fibula, and the articular surfaces of the bones of the knee joint on the left side. After one month's treatment by the Castellani mixture he was able to walk with considerable ease. The case failed to come for further treatment and could not be followed.

Cases X, XI, XII, XX, XXI, XXIII, XXIV, XXV, XXX, and XXXI are of minor interest and are only referred to in Table I.

CONCLUSIONS

1. The majority of cases of yaws with bone and joint involvement shows characteristic roentgen ray lesions.

2. The radiograph can be used as an additional means of differentiating yaws from syphilis, when there is involvement of the bone, and as a confirmation of the evidence that the two diseases are distinct.

3. The pains complained of in the joints are due, in most part, to the presence of the lesions on the articular surfaces.

4. Twenty per cent of patients infected with yaws develop bone or joint lesions when not treated.

5. Regeneration of the bone is complete at the site of the lesion, if the destruction has not been too great.

6. The Castellani treatment causes a gradual disappearance of the bone and joint lesions.

7. Salvarsan is a specific in these cases, and rapid regeneration of bone follows its use.

I wish to express my appreciation to Doctors Crowell, Guerrero, Fernandez, Domingo, and Argüelles for their help and courtesies shown while doing this work, and to Mr. Hallare, who acted as interpreter and furnished most of the histories of the cases.

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PAIN IN THE LUMBOSACRAL REGION ASSOCIATED WITH CONGENITAL MALFORMATION OF THE TRANSVERSE PROCESSES OF THE FIFTH LUMBAR VERTEBRA *

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AMONG the patients sent to the roentgen ray department with a clinical diagnosis of strain, relaxation or arthritis of sacroiliac joints, or arthritis of hip, sciatica, lumbago or even possibly Pott's disease, we have noted the great preponderance of anomalies in the structure of the bones of the lumbosacral region, particularly of the transverse process of the fifth lumbar vertebra.

It has been mentioned by several authorities that the radiographs showing the lumbosacral region rarely presented an appearance that could be called perfectly normal. However, it is remarkable that in examining plates of that region which have been made for genito-urinary examinations or for some other non-orthopedic complaint, one finds a very much smaller percentage of anomalies in the structure or the situation of the bones.

Our examination of about sixty patients who came to the hospital complaining of pain in the lumbosacral region, has shown that only about 10 per cent did not present abnormalities. Of those, 60 per cent were slight or pronounced malformations of the transverse processes of the 5th lumbar vertebra; and we think

GROUP 1. The left transverse process is higher than normal and signs of a slight degree of arthritis are observed in the right sacro-iliac joint.

GROUP 2. Male, aged 35, complains of pain in the lumbosacral region for the past 10 months but cannot state definitely when or how it began, as there was no history of trauma or sudden onset. There is pain at all attempts of motion of the spine which radiates to the buttocks and thighs when standing or lying, but it is less pronounced in the latter position.

The radiogram shows the fifth lumbar vertebra low but not sacralized. Both fifth transverse processes are large and directed obliquely upward.

* Read at the Clinical Meeting, Section of Orthopedic Surgery, at the New York Academy of Medicine, March 21, 1919.

that in nearly all these cases the pain, local or radiating, was caused directly or indirectly by this malformation. Owing to the wide difference in extent of these malformations, we can classify them in four different groups, each case presenting one or several characteristics of a particular group:

First Group.—One or both transverse processes are longer and larger than normal; they may apparently be in contact (constant, or in certain movements only) with the sacrum and iliac bones. Their shape sometimes suggests a change directly traceable to this contact; or the formation of a bursa at the point of contact is indicated.

Second Group.—One or both fifth lumbar transverse processes are very markedly long or large and seem to have taken an oblique upwards direction from this contact with the sacrum and iliac bones; the space between the lower border of the process and the upper border of the sacrum appears very narrow and sometimes it has entirely disappeared.

The two preceding groups are not so much true malformations of the transverse processes, as malposition of the bones of the pelvis; the sacrum is apparently situated very low between the iliac bones. This is more frequent in males than in females.

GROUP 3. Male, aged 30, who complains of pain over the left sacro-iliac region for the last 15 months. There is no pain in the hips or ischiatic regions. Marked rigidity of the lower lumbar spine with sharp pain and spasms of the muscles was produced upon all attempts of motion.

The radiogram shows the right transverse process probably touching the sacrum and ileum, but no sign of the formation of a calcified bursa. The tip of the left process is deflected upward.

GROUP 4. Man, aged 37, who for one year has complained of pain in the lower back and a dull pain in both hips but most marked in the left side. There is no history of trauma.

The radiogram shows sacralization of the transverse processes of the fifth lumbar. The left process has developed into a large wing which articulates with the left part of the sacrum by joint. This shows signs of arthritis. The right transverse process is less developed but it articulates with the ilium and sacrum.

In plates that can be considered as showing a normal shadow, the upper surfaces of the fifth transverse processes are about on, or slightly below, the upper border of the crest of the iliac bone, this position showing little change in different plates taken at a higher or lower angle. There must be at least an apparent distance of three-fourths of an inch between the lower borders of the

processes and the upper surfaces of the sacrum, and between the ends of the processes and the borders of the iliac bones, respectively.

Third Group.—This group is represented by the very marked enlargement outwards and downwards of the fifth lumbar transverse processes which present a size two or three times that of the process on the opposite side, its shadow overlapping the shadow of the upper part of the iliac bone and sacrum, with sometimes the presence of a bursa, but no actual joint formation.

GROUP 4. Unilateral. Girl, aged 21, treated for scoliosis five years ago for which she wore a plaster cast. At the time of admission she had complained of pain in the sacral region for several weeks which was more marked on the right side but it radiated to both hips.
The radiogram shows a very large right fifth lumbar transverse process which is articulated to the sacrum by a true joint. In these joints I find signs of arthritis. The space between the lateral process and the sacrum seems to be reduced. Slight degrees of arthritis are also demonstrable in both sacro iliac joints, slightly more pronounced in the left.

GROUP 4. Bilateral. A woman aged 32 years who complains of pain of two weeks' duration in the lumbosacral region. Only slight pain is elicited by pressure over the sacro-iliac articulations. There is also slight limitation of all movements. Hyper-extention of the lumbar spine causes pain radiating to the hips.
The radiogram shows sacralization of both fifth lumbar transverse processes by true joints. Signs of a slight degree of arthritis can be seen at the lower border of the left sacro-iliac joint.

Fourth Group.—This group would include the malformation of one or both fifth lumbar transverse processes which are considerably larger than normal and united with the upper part of the sacrum by a true joint. In fifty plates showing malformations of the fifth lumbar transverse processes, we have found thirteen that may be classified in this fourth group. The malformation was unilateral in eight cases, bilateral in four cases.

In all cases the vertebra bearing the malformed transverse process or processes is a *true* fifth lumbar, the sacrum showing the regular number of segments and the transverse process of the vertebra above presenting the characteristic aspect of the fourth lumbar.

The histories of the patients bearing one or several of these four groups of anomalies are remarkably alike. About two-thirds of them are male patients. They came to the Hospital complaining of pain of a duration extending from a few days to several years; the period of their life when the pain is stated to have begun is rarely before their twenty-fifth year. Very few of them mention or recall a trauma or jerk preceding or starting the pain, and when there

has been an accident, they often recall that they had felt some pain prior to it.

The clinical examination usually shows tenderness by pressure over the region of one or both sacro-iliac joints, limitation of motion of the lumbar spine with spasm and pain, the sharpest pain being encountered in movements of extension or hyperextension. There is often rigidity of the spine up to the middle dorsal region.

The patients also very often complain, even in repose, of pain in the lumbar and ischiatic regions, in the hip joints and different groups of muscles in the thighs and legs.

The clinical symptoms explain why sometimes these patients have been referred for roentgen ray examination with a temporary diagnosis of Pott's disease.

The examination of the radiographs of these patients seems to give, in almost all the cases, an explanation of the symptoms found at the clinical examination.

We may consider the pain as being produced either:

(1) By compression of soft tissues, muscular or fibrous (ligaments) between the bony parts.

(2) By irritation and arthritis of normal or abnormally formed bursæ and joints.

(3) By the slow acting strain on ligaments when a very slight relaxation of the joints of this region is produced (these joints normally allowing only extremely limited movements).

(4) By pressure or tension due to the persistent malposition of the bones on different segments of the trunks of the nerves which emerge from the lateral foramen of the fifth lumbar vertebra, especially of the lumbosacral cord.

The presence of these anomalies also facilitates the production of slight traumatic displacements which leave behind them sprains; it also facilitates the anterior displacement of the fifth lumbar vertebra or spondylolisthesis, and is sometimes the primary cause of scoliosis.

The fact that the ossification and union of the segments of the sacrum are not complete before the twenty-fifth year, often later (the upper segment being the last one to be completely ossified) explains why these patients rarely suffer before this age.

In fact, until the ossification is nearly completed, real contact between a large fifth transverse process and the sacrum or ilium is not produced or the tissues which come in contact are not hard, and yield easily to pressure. The abnormal joint or bursa therefore is not formed. With the completion of ossification, if the pressure of the enlarged process is made on the sacrum, there may be a tendency to lateral tilting of the fifth lumbar and, in the upright position, a tendency to compensatory opposite tilting of the sacrum, which causes strain on both sacro-iliac joints and subsequent arthritis, this arthritis being generally more marked on the side opposite to the malformation.

If the pressure of the process is made on the iliac bone, it causes a direct strain, a stretching of the ligaments of the sacro-iliac joint at the same side with subsequent arthritis on both sides. Arthritis is also generally more marked at the side opposite to the malformation.

It has often been doubted whether this kind of malformation was able to cause pain by direct pressure on nerves or by tension due to persistent malposition. When the malformation is unilateral the patient generally complains of pain over the region of both sacro-iliac joints, the pain often being more severe on pressure of the joint opposite the malformation. On the other hand, the pain radiated to the hip, buttock, ischiatic region, also to the thigh and leg, is generally felt on the same side as the malformation. If we consider now that the anterior ramus of the fifth lumbar nerve runs over the upper part of the sacrum, we may suppose that the narrowing and, even in certain cases, the apparent suppression by an enlarged fifth lumbar transverse process of the space between the transverse process and the sacrum, may cause a certain amount of

compression of the nerve, or tension by lengthening its way downward.

This nerve springs from the lumbosacral cord and contributes to the sacral plexus. A pressure or tension on any part of it may be an explanation of the pain radiating to the hip, buttock, thigh and leg. And for the same reason that the development of the upper part of the sacrum is not complete before the twenty-sixth or thirtieth year, the pressure or tension is not made until full development is nearly reached, the pain having appeared insidiously; and this explains why most of these patients recall only with difficulty the time when they began to suffer.

How this malformation can facilitate spondylolisthesis, which gives, for about the same reasons, pains analogous to that above mentioned, is shown by the examination of the skeleton; the upper part of the sacrum (ala) at either side of its articular surface consists of two planes oblique anteriorly and downwards; if then a movable part, as a very large fifth lumbar transverse process, makes a downward pressure on these sacral planes, it will obviously take an anterior downward direction, thus facilitating the forward displacement of the fifth lumbar, especially if there is already a predisposing affection of the vertebra, as a defective ossification of its foramen, or spondylolisthesis.

That the malformation of a fifth lumbar transverse process may be the primary cause of scoliosis has often been described by authorities.

In the examination of fifty scoliosis patients, six showed a marked difference in the size of the transverse process of the fifth lumbar, this being associated with or without the presence of hemivertebræ, or a supernumerary vertebra.

But in several patients the lower lumbar vertebræ were rotated to such a degree as to render impossible a clear view of the fifth lumbar transverse processes.

When scoliosis is due to a marked inequality in the size of the fifth lumbar transverse process, the primary curvature has its convexity opposite to the side of the larger process, the secondary curvature being dorsal, always very much more pronounced, with convexity on the same side as the large process. The primary lumbar curvature often disappears before any corrective treatment has been undertaken. It is to be noted that in the cases where there are only four lumbar vertebræ, without anomalies of the upper part of the sacrum, the lateral processes of the last lumbar vertebra present the characteristics of the fourth lumbar transverse processes.

Upon reexamining the patients whose plates of the sacral region (without showing the whole lumbar spine) did not seem to show anything abnormal, but where the transverse processes of the last lumbar vertebræ presented the characteristics of the fourth lumbar processes, we have found in all only four lumbar vertebræ. In these cases the sacrum shows always six or seven foraminæ instead of four or five as normal, the fifth lumbar contributing in its entirety to the formation of the sacrum. The pain of the patient bearing this abnormality was almost always found to be due to some other cause than an orthopedic affection.

The malformations of the fifth and sometimes of the fourth lumbar transverse processes thus prove to be an incomplete attempt of the fourth and fifth lumbar vertebræ to participate in the formation of the sacrum, the non-completion of this attempt creating the condition which causes pain.

When six lumbar vertebræ are found, the sacrum does not show a smaller number of lateral foraminæ. These cases of six lumbar vertebræ are very rare, compared with those of four, the ratio being about one to ten.

The great number of these complete or incomplete attempts at participation of the fourth and fifth lumbar vertebræ in the formation of the sacrum seem to support the theory advanced by some anatomists and orthopedic surgeons that the number of joints of the spine is too great for the actual "modus vivendi" of man, and that,

through the slow evolution which tends to suppress organs that are used little or not at all, the pelvic girdle is coming nearer to the scapular girdle, the lower lumbar region being subjected in actual life to very few movements of limited extent.

These malformations of the fourth and fifth lumbar vertebræ do not therefore seem to belong to the same class of congenital malformations found in the other parts of the spine; such as defective or supernumerary vertebræ, hemi- or entire (which are accidents in the metamerism of the embryo), but are a more or less perfected phase of the evolution of the human skeleton.

Before closing this discussion, we must add that the roentgenological conclusions about the position of the bones of the lumbosacral region can rarely be arrived at without making several plates taken from different angles, above and below the level of the upper border of the sacrum. The stereoscope does not seem to help a great deal in this investigation. The lateral view is not of great value as far as the examination of the fifth lumbar transverse processes is concerned, but is of first importance, when obtainable, to appreciate the extent of spondylolisthesis or the degree of the backward tilting of the sacrum.

THE VALUE OF RADIUM IN CURING DISEASE, IN PROLONGING LIFE, AND IN ALLEVIATING DISTRESSING SYMPTOMS *

BY W. H. B. AIKINS, M.D.

TORONTO

DURING the comparatively short time which has elapsed since radium was first introduced into therapeutics, the treatment has passed through many phases, but it is now being established upon a firm and scientific basis, and is slowly, but surely, enormously extending its field of usefulness. A few brilliant successes in its early days caused it to be hailed by over-enthusiastic advocates as an almost universal panacea, while on the other hand a certain number of failures resulted in its unconditional condemnation by some of the more conservative members of the profession, who are invariably inclined to be sceptical in regard to the merits of any new remedy. Further investigation and more extensive experience, however, have shown that for many of these failures radium itself was not to blame, but a defective knowledge of its exact characteristics, dosage and method of application, and in some instances an injudicious selection of cases for the treatment, which, in common with every other method, has its limitations. The absolute necessity of recognizing these, and giving them due consideration, before expressing a definite opinion as to the value or otherwise of radium treatment, will be obvious. Meanwhile, though the value of new remedies can only be accurately determined by prolonged experience and observation, it is advisable to approach the subject with an open and unbiased mind, and not hesitate to avail ourselves of any means which offers of removing or alleviating the terrible suffering caused by the diseases with which humanity is liable to be affected. Everyone will agree that cancer is one of the most important of these diseases.

A want of knowledge as to the proper dosage has been responsible for failure in not a few cases, either too much or too little radium being given. The use of too small an amount of radium may account

* Read at the meeting of the American Radium Society, Atlantic City, June 9, 1919.

for failure, as an inadequate dose is said to have the effect of stimulating a malignant growth instead of attaining the desired object of inhibiting it.

While it is now generally recognized that radium is dependent for much of its efficiency upon the fact that in cancer it exerts a selective destructive influence upon the cells of the new growth, there is no doubt whatever that it also affects normal tissue destructively to a certain extent; and caution is therefore necessary lest, while we increase the dose in the hope of increasing its power to destroy the cancer cells, we do so to such an extent that it has a disastrous effect on the normal tissue. When a lesion is deeply situated, increased dosage will to a certain extent compensate for its increased depth; but such an increase is necessarily limited by the necessity of stopping short of such a dose as will entail the risk of serious injury to the normal tissue. This makes it imperative that the principles of dosage should be definitely established, and its limitations and variations in individual cases thoroughly understood. The investigations which have been carried out in recent years have added much to our knowledge in this respect, have reduced the risks, and thus greatly extended the field of usefulness of radium therapy.

Darier and others are of opinion that another factor which has sometimes led to the discredit of radium treatment, is that in dealing with cancer of the skin the absolute necessity of making an accurate diagnosis of the particular variety of cancer present before proceeding to treat it with radium has not been sufficiently recognized. This is of importance, in view of the fact that all the varieties of cancer which affect the skin do not respond equally well to radium. This applies especially to the squamous and spino-celled epithelioma, which tends to rapid involvement of the ganglia and metastasis, and usually leads to a fatal result in less than two years. Melanotic sarcoma originating in nevi is also not so amenable to radium. Malignant disease, the etiology of which still remains more or less of a mystery, holds a prominent position among the morbid conditions for which we have for many years past been anxiously seeking a remedy, and was one of the first, and is still one of the chief conditions for which radium is employed. In the early days its use was largely restricted to the superficial forms, but its beneficial effects gradually led to its use in more deeply situated cancerous growths, such as cancer of the uterus and other internal organs. The cases of this kind which were at first submitted to radium were, as a rule, those in very advanced stages of malignancy, in which surgery and all other measures had failed, and radium was applied only as a last resource when the patients were in a desperate condition. Under these circumstances it was obviously unfair to blame the remedy for its failure to bring about a cure, but in spite of this cases have been reported from time to time in which the local manifestations have disappeared and the life of the patient has been prolonged.

After the many vicissitudes through which radium therapy has passed since its first introduction into therapeutics, it may be said to occupy at the present time a firmly established position, and in some conditions, notably cancer of the face, it may be regarded as preeminently the treatment of election, as it can be relied upon to bring about a complete and permanent cure in a very large proportion of cases, without leaving the disfiguring and contracted scars which so often result from surgery, and which so frequently are the site of recurrence of the trouble. In the treatment of such cases there is none other which can compare with radium in the excellence of its cosmetic results. A further recommendation of radium in this connection is the ease and painlessness with which it can be applied.

The treatment of more deeply situated cancer has been attended with varying results, sometimes in desperate and in-

operable cases with the most unexpected success. While there is no doubt that a sufficiently extensive surgical operation, provided it is possible to remove all the cancer cells present, gives a fair prospect of recovery and freedom from recurrence, if the disease is allowed to progress it reaches a stage when surgical removal is impossible. In these advanced cases, which are hopeless from the point of view of surgery, radium has shown itself to be invaluable, and it now appears to be definitely established that it exerts a reliable influence upon many forms of malignant growth.

As regards the effects of radium upon the cancer cells, in a recent editorial in the *Lancet* the process is described as follows: "The cells become granular and break up, and sometimes vacuoles appear until absorption of the débris occurs, and after a time a shrunken cell membrane is all that remains of the formerly malignant cells. Then there appears new fibrous tissue, the amount varying in different cases, and thus, if a successful result is obtained, the malignant growth is replaced by a fibrous nodule, while in some cases the cure is so complete that no trace whatever is left of the malignant disease." This destructive influence is exerted on forms of living tissue, but is decidedly greater on the pathological cells than on the healthy tissue.

THE VALUE OF RADIUM IN CURING DISEASE

Among the most brilliant results which have been obtained from radium from this point of view are those in cancer of the skin and mucous membranes. This applies especially to basal-celled epithelioma and rodent ulcer. Other types of epithelioma are more refractory, most notably the squamous-celled variety, those accompanied by peripheral lymphangitis, and those recurrent in a cicatrix. Owing to this it was believed a few years ago that such forms of cancer were incurable by radium, but it is now generally recognized that the reason for failure was insufficient dosage. The squamous-celled variety of epithelioma required three or four times as much radiation as the basal-celled variety in order completely to eradicate the disease and thus make recurrence improbable.

One great advantage of radium over surgery is that it leaves supple skin, with very little scar formation, whereas after operation there is a contracted scar, which is frequently the site of recurrence, owing to the irritation to which it is constantly subjected. I have frequently noted a reappearance of the disease at the site of stitches. The value of this will be appreciated when we remember that one of the facts definitely established in regard to cancer is that irritation is an important factor in its etiology.

Radium has also a wide field of use in the disease of the skin and mucous membrane other than malignancy,—so much so that its employment by modern dermatologists is almost imperative. Benign tumor growths, such as moles, warts, papillomata, are removed by it, while in the treatment of disfiguring birthmarks, either port-wine stains or angiomata, it is the method of election, as its application is easy and painless and its cosmetic results are not attained by any other method.

In keloid, lupus, erythematous, tuberculosis of the skin in its various aspects, it is of the greatest value. Leucoplakia of the buccal mucosa or tongue, which is often the forerunner of malignancy, responds favorably to radium therapy.

A recent report of the London Radium Institute states that experience there tends to show that rodent ulcer can be cured with certainty by the application of radium, and, provided a sufficient dose is given, does not recur.

In the treatment of cancer of the lip, both in early and advanced cases, results are equal or superior to those of surgery, more than 90 per cent of the early cases being permanently cured without residual deformity, and also a fair proportion of the advanced cases. When we compare the

90 per cent of cures without recurrence with the results of surgery in this condition, the superiority of the radium treatment is obvious. The literature of the subject shows that radical operation at an early stage, when there is no obvious affection of the glands, is followed by recurrence in more than 50 per cent of the cases, and if the glands are involved at the time of operation, in more than 90 per cent.

The value of radium in treating sarcomatous tumors of the skin, and some more deeply seated, is well established.

Another condition in which the success of radium has been so remarkable that it has come to be regarded as the method of election, is that of fibroids of the uterus. In uncomplicated cases, however severe, experience indicates that it can be relied upon to arrest hemorrhage and discharge, bringing about amenorrhea, and it will also cause shrinking or complete disappearance of the tumor.

Cases treated as long ago as 1905, when radium therapy was in the experimental stage, have remained well; and in many large gynecological clinics the use of radium has almost superseded operation in fibroids and certain forms of uterine hemorrhage. The only exceptions made are in cases in which the diagnosis is doubtful, in those in which the fibroids are suppurating, and in those in which symptoms of pressure render operation imperative. An advantage of radium in these cases as compared with the roentgen rays, which are also successful in arresting hemorrhage and bringing about amenorrhea, is that radium can be brought into direct contact with the diseased uterus, while the influence of roentgen rays depends largely upon their action upon the ovaries. In the presence of sub-mucous fibroids, associated with endometritis, radium arrests the hemorrhage by a primary action upon the endometrium and a secondary effect upon the ovaries, but with the roentgen rays the reverse takes place, and as a result the symptoms of the menopause due to radium are much less than those due to the action of the roentgen rays. In cases which are inoperable, owing to the severity of the hemorrhage, radium will often arrest the hemorrhage and thus render the condition operative.

As regards cancer of the uterus, the mortality after surgery has been very great, even with the best technique and in the hands of the most skilful surgeons. The general opinion is that operation should be performed in every operable case, but that the use of radium after operation will tend to prevent recurrence, and thus increase the percentage of cures. In some instances the use of radium in an inoperable case will render a radical operation possible. A very large proportion of these cases are already inoperable when they first come under the observation of the surgeon.

In the therapy of Grave's disease or exophthalmic goiter, a judicious use of the radium rays will in many cases produce results which are nothing less than brilliant, combined of course with the usual medical measures of rest, diet, medication, etc. Radium applied over the thyroid slows the rapid pulse, lessens the nervous excitement, causes a variable degree of shrinkage of the gland and in numerous cases has rendered quite unnecessary the surgical operation which has been proposed as a last resort of treatment.

THE VALUE OF RADIUM IN PROLONGING LIFE

Those who express unfavorable opinions as to the value of radium therapy frequently do not consider sufficiently the fact that a very large number of the cases submitted to its treatment are in the last stages of cancer, when the growth is so extensive that surgery is powerless, and the patient is so ill that the fatal termination of the disease is imminent. In these cases radium is only used as a last resource, and it has frequently done what no other known form of treatment is capable of doing. In cases of inoperable cancer in the uterus and other regions, radium often causes

disappearance of the local manifestations, and in certain cases cure has been affected in an apparently hopeless case. Life may thereby be prolonged for months or even years, although the patient may succumb subsequently to metastasis in other parts of the body.

Postoperative radiation is now regarded as a most important part of radium therapeutics. Many cases of cancer of various forms have been reported, in which the patient has remained without recurrence for three or four years or more after the radium treatment, sometimes for such a prolonged period that cure may be assumed. In other cases the growth may become so much reduced in size that a previously inoperable case may become operable. In the Report of the London Radium Institute, issued at the end of 1918, it is stated that between 1911 and 1914 a large number of cases were operated upon by surgeons of high standing and the operations were so extensive that, in the opinion of the operators, recurrence was inevitable. After postoperative treatment with radium, recurrence took place in less than 20 per cent of the cases, a result which is believed to be unequalled in the records of selected cases operated upon by surgeons of extensive experience.

When radium is applied over the enlarged spleen, it has a favorable influence in myelogenous leukemia. It is a well-known fact that this is one of the most hopeless conditions in the whole domain of medicine, and the literature of the subject indicates that practically all cases terminate fatally, the acute in a few months, the chronic in from two to four years. Ordway, Peabody, Griffin and Clarkson have recently discussed the treatment of this condition by the application of radium. The reduction of the white count is most remarkable, especially in the acute cases, and the size of the spleen is greatly decreased. Many of the patients have been able to return to their occupations for a time at least. These writers consider that radium is the best remedy we have at present. Should splenectomy be considered necessary, Griffin has shown that the operative mortality would be considerably reduced if operation could be performed at a time when the spleen was comparatively small, freely movable, and the general condition good. The first splenectomy for myelogenous leukemia was reported by Bryant in 1866, the patient dying about two hours later. From this time up to 1915, 51 cases were reported with an operative mortality of 86 per cent. Mayo and Balfour have reported their results in 18 cases which were treated by preoperative radium at the Mayo clinic. The spleen was much reduced in size, the operation easily performed, and the only postoperative complication was a case of peritonitis. Eight of the cases remained alive from nine months to three years after the treatment.

It has been demonstrated experimentally that the blood, spleen, bone marrow and lymph nodes are normally the most sensitive organs in the body to the action of radium and the *x*-rays. A few hours after irradiation there is a destruction of the cells of the lymphoid tissue and spleen and there is also a disappearance of cells in the bone marrow. In the bone marrow the cells most easily affected are the lymphocytes and non-glandular myelocytes. This destructive effect is much more marked in the leukemic than in the normal animal, and in some cases after six weeks' treatment, the white count has fallen from 1,250,000 to 8,000. In view of these results the possibility is suggested that if treatment could be begun at a sufficiently early stage, and continued long enough, the spleen, bone marrow and lymphatics might be influenced so favorably that the excessive production of immature forms of leucocytes might be definitely and permanently inhibited.

Even in cases in which the general condition is extremely bad, the radium treatment may be followed by marked improvement and increase in strength and weight, and there may be remissions of longer or shorter duration. Though death will ultimately supervene, there is no question

that the treatment may prolong life for a number of years. It remains a question whether cure will ultimately be obtained by means of improved technique or by treatment at an earlier stage, but it must be conceded that results already obtained are sufficiently remarkable. In Hodgkin's disease also there is marked general improvement and reduction in the size of the affected lymphatics; but in order to obtain this result it is necessary to persevere with the treatment.

THE VALUE OF RADIUM IN ALLEVIATING DISTRESSING SYMPTOMS

While I do not wish to minimize the curative value of radium, or its value in the prolongation of life, it must be admitted that in many cases the prolongation of life alone would be a doubtful blessing, owing to the distressing symptoms which render life a burden, not only to the patient himself, but often to those around him. In this direction radium has conferred one of the greatest benefits upon humanity. Radium has frequently been proved superior to every other known form of treatment, in that it has been able to control successfully the unpleasant symptoms associated with the last stages of malignant diseases in cases where recovery is apparently hopeless. Thus it renders the last weeks or months of the patient's life tolerable and comparatively comfortable. In not a few of these desperate cases the local symptoms have completely disappeared, or the growth has diminished to such an extent that operation can be performed with a fair prospect of success.

All authorities are agreed that in many very advanced cases of cancer of the uterus, radium relieves the pain, reduces the discharge and hemorrhage, and causes the disappearance of the unpleasant odor which is such a trial to the patient and her friends. In addition to this, unexpected apparent cures have been reported in some of these cases, and in those not ultimately cured there is marked relief of the symptoms.

During the war radium was used extensively in the treatment of wounds. It has been found most useful in dealing with vicious cicatrices of various kinds, when they are associated with painful symptoms due to inclusion of nerve fibers or trunks, or when they interfere with the mobility of joints. In such cases the application of radium has frequently led to the restoration of normal mobility, to loosening of tendinous and muscular adhesions and also to resumption of the function of compressed nerves. It has also given great relief in cutaneous manifestations, which have been observed so often in connection with war wounds and which are very refractory to ordinary methods of treatment. These are most frequently due to the excessive use of strong antiseptics, such as tincture of iodine, and have as a rule responded well to radium therapy. Degrais and Bellot report a series of excellent results in functional impairment following war wounds. They state that in vicious cicatrices radium acts in four ways: first, it transforms the cicatricial tissue into supple connective tissue; second, it dissolves and levels keloid tissue; third, it detaches the cicatrix from adherent deep tissues; and lastly, it liberates compressed nerve fibres, causing disappearance or amelioration of motor or sensory troubles.

There is no doubt that the present position of radium therapy is very encouraging, and such as to give rise to great hopes for the future. There is no question as to its value as an adjunct to surgery, both before and after operation, and the results of prolonged experience leave no excuse for ignoring its usefulness in this connection. But perhaps the greatest benefit it has conferred upon humanity consists in the relief it has afforded to countless patients whose condition is absolutely hopeless from the point of view of cure. Even if it had never succeeded in curing a single case, radium has amply justified itself by its palliative properties.

LEGAL RIGHTS OF THE ROENTGENOLOGIST AS A WITNESS

BY JOSEPH FRIEDMANN, M.D.

NEW YORK CITY

ONE of the evils which the roentgenologist has to contend with is the subpœna duces tecum, which calls him into court with plates in his possession, to testify when the case reaches trial months and months after the examination was made. This often works hardship to the roentgenologist if it is not thoroughly specified before, what compensation he shall receive. But in the eyes of the law, the fact should not be forgotten that he need not testify unless it is agreed that he is to receive compensation as an expert, and he may take this stand before the presiding Justice after the question is asked, "Are you an expert roentgenologist?" If the answer is "Yes," and he qualifies as such, then he need answer no questions unless compensated as an expert. This, if clearly held in mind, will save many embarrassing situations, loss of time, etc.

The above statement was made at the mid-winter meeting of the American Roentgenologists, held at Atlantic City, January 24, 1919. At the request of some of the audience I made a more careful search into the matter from a legal standpoint.

A study of the subject of expert testimony in general, was carefully compiled from the reports of the District of Columbia, the states of Iowa, Maine, Massachusetts, Minnesota, North Carolina, Indiana, Arkansas, Colorado, Georgia, Illinois, Missouri, Nebraska, New Jersey, Pennsylvania, Texas, Wisconsin, Louisiana and New York, and also a number of court records and reports of the Canadian provinces.

In a number of the states, the statute distinctly provides for an allowance in addition to the ordinary fee to expert witnesses who testify as to matter of opinion; and a number of authorities have gone so far as to hold that an expert witness may refuse to testify until his extra compensation is paid or secured, and is not guilty of contempt in so doing.

Apart from the statute, a written opinion presented to me by a member of the bar claims that an expert witness may be compelled to testify as to matters of professional opinion, of matters of which he has gained a special knowledge by reason of his professional training or experience, without any compensation other than the fee of an ordinary witness, and his refusal to testify unless paid an extra compensation may be punished as contempt.

He further states: "And *a fortiori* a professional man who attends as an ordinary witness as to facts which have come within his observation, rather than as an expert in any matter relating to his profession, is entitled to only the ordinary witness' fees. Where, however, it is desired to have an expert witness give testimony of a nature which requires special preparation, investigation, research or examination of any kind by him, in order to prepare himself to testify, he has a right to regard such preparatory work as a professional service, and cannot be compelled to perform the same without the payment of a professional fee." This seems clearly to establish that the roentgenologist, who must prepare himself by special technique and skill in exposing and developing his plates, and in their interpretation in addition to his special training in the care and conduct of his apparatus, including tubes, coils, converters, transformers, etc., is a highly specialized expert, and that there need be no quibbling in the minds of the learned jurists before whom he may appear as to his being such, particularly as each case in itself must subsequently

be studied very carefully before a professional opinion can be promulgated with reasonable certainty as to the ultimate outcome of a case.

The following shows a complete and thorough résumé of all the opinions in the different courts up to date, and any subsequent opinions which may have been rendered by different legal tribunals are of cases which have been pending and in which the decisions were subsequently rendered.

COMPENSATION OF EXPERTS

In some jurisdictions the statutes provide for the allowance to expert witnesses, who testify to matters of opinion, of an extra compensation in addition to the ordinary witness fee:

District of Columbia.—U. S. v. Cooper, 21 D. C. 491.
Iowa.—Keller v. Harrison, 151 Iowa 320, 128 N. W. 851, 131 N. W. 53; Snyder v. Iowa City, 40 Iowa 646.
Maine.—Gordon v. Conley, 107 Me. 286, 76 Atl. 365.
Massachusetts.—In re Clark, 104 Mass. 537.
Minnesota.—Farmer v. Stillwater Water Co., 86 Minn. 59, 90 N. W. 10 (where hydraulic engineers were allowed twenty and twenty-five dollars per day); State v. Teipner, 36 Minn. 535, 32 N. W. 678.
North Carolina.—State v. Dollar, 66 N. C. 626.

See 50 Cent. Dig. tit. "Witnesses," Section 65.

and some authorities have gone so far as to hold that an expert witness may refuse to testify until his extra compensation is paid or secured:

Turnbull v. North British R. Co., 5 Sc. Sess. Cas. (5th ser.) 944; Marquis v. Robidoux, 3 Quebec Pr. 433; Guinea V. Campbell, 22 Quebec Super. Ct. 262.

If the witness voluntarily testifies without insisting upon compensation as a condition of giving his testimony, he cannot recover from the person in whose behalf he testifies more than the statutory witness' fee. Tiffany v. Kellogg Iron Works, 59 Misc. (N. Y.) 113, 109 N. Y. Suppl. 754.

and is not guilty of contempt in so doing.

Buchman v. State, 59 Ind. I, 26 Am. Rep. 75 (followed in Dills v. State, 59 Ind. 15); U. S. v. Howe, 26 Fed. Cas. No. 15, 404a. But compare Gaston v. Marion County, 3 Ind. 497.

But the more general rule is that, apart from statute, an expert witness may be compelled to testify as to matters of a professional opinion, or matters as to which he has gained a special knowledge by reason of his professional training or experience, without any compensation other than the fee of an ordinary witness:

Arkansas.—Flinn v. Prairie County, 60 Ark. 204, 29 S. W. 459, 46 Am. St. Rep. 168, 27 L. R. A. 669 and note (followed in Clark County v. Kerstan, 60 Ark. 508, 30 S. W. 1046).
Colorado.—Larimer County v. Lee, 3 Colo. App. 177, 32 Pac. 841.
Georgia.—Schofield v. Little, 2 Ga. App. 286, 58 S. E. 666.
Illinois.—Wright v. People, 112 Ill. 540.
Massachusetts.—Barrus v. Phaneuf, 166 Mass. 123, 44 N. E. 141, 32 L. R. A. 619.
Minnesota.—State v. Teipner, 36 Minn. 535, 32 N. W. 678.
Missouri.—State v. Bell, 212 Mo. 111, 111 S. W. 24; Burnett v. Freeman, 134 Mo. App. 709, 115 S. W. 488; Burnett v. Freeman, 125 Mo. App. 683, 103 S. W. 121.
Nebraska.—Main v. Sherman County, 74 Nebr. 155, 103 N. W. 1038.
New Jersey.—See Fonda v. Bolton, 6 N. J. L. J. 240.
Pennsylvania.—Com. v. Higgins, 5 Kulp 269. See also Ramschasel's Estate, 24 Pa. Super. Ct. 262.
Texas.—Summers v. State, 5 Tex. App. 365, 32 Am. Rep. 573.
Wisconsin.—Philler v. Waukesha County, 139 Wis. 211, 120 N. W. 829, 131 Am. St. Rep. 1055, 25 L. R. A. N. S. 1040 and note, 17 Ann. Cas. 712 and note.
Canada.—Butler v. Toronto Mutoscope Co., 11 Ont. L. Rep. 12, 6 Ont. Wkly. Rep. 527, 5 Ann. Cas. 992 and note.

See 50 Cent. Dig. tit. "Witnesses," Section 65.

Witness cannot recover additional compensation on a quantum meruit. Chicago, etc., Electric R. Co. v. Judge, 135 Ill. App. 377.

Extra compensation may be recovered on express promise. Barrus v. Phaneuf, 166 Mass. 123, 44 N. E. 141, 32 L. R. A. 619; Dixon v. People, 168 Ill. 179, 48 N. E. 108, 39 L. R. A. 116 (affirming 63 Ill. App. 585, and followed in North Chicago St. R. Co. v. Zeitger, 182 Ill. 9, 54 N. E. 1006, 74 Am. St. Rep. 157 [affirming 78 Ill. App. 463]).

and his refusal to testify unless paid an extra compensation may be punished as contempt:

Ex. P. Dement, 53 Ala. 389, 25 Am. Rep. 611; State v. Darby, 9 Ohio Dec. (Reprint) 725, 17 Cinc. L. Bul. 62.

A fortiori a professional man who attends as an ordinary witness as to facts which have come within his observation rather than as an expert in any matter relating to his profession, is entitled to only the ordinary witness' fees.

Iowa.—Snyder v. Iowa City, 40 Iowa 646.
Minnesota.—Anderson v. Minneapolis, etc., R. Co., 103 Minn. 184, 114 N. W. 744; Le Mere v. McHale, 30 Minn. 410, 15 N. W. 682.
New York.—Lyon v. Wilkes, 1 Cow. 591.
Pennsylvania.—Com. v. Lucas, 24 Pa. Co. Ct. 126.
Canada.—Gardner v. Marchildon, 5 Quebec Pr. 323. See also Marquis v. Robidoux, 3 Quebec Pr. 433.

See 50 Cent. Dig. tit. "Witnesses," Section 65.

Where, however, it is desired to have an expert witness give testimony of a nature which requires special preparation, investigation, research, or examination of any kind by him in order to prepare himself to testify, he has a right to regard such preparatory work as a professional service, and cannot be compelled to perform the same without the payment of a professional fee:

Arkansas.—Flinn v. Prairie County, 60 Ark. 204, 29 S. W. 459, 46 Am. St. Rep. 168, 27 L. R. A. 669 and note (followed in Clark County v. Kerstan, 60 Ark. 508, 30 S. W. 1046).
Colorado.—Larimer County v. Lee, 3 Colo. App. 177, 32 Pac. 841.
Georgia.—Schofield v. Little, 2 Ga. App. 286, 58 S. E. 666.
Indiana.—Gaston v. Marion County, 3 Ind. 497.
Louisiana.—Harrison v. New Orleans, 40 La. Ann. 509, 4 So. 133.
Massachusetts.—Barrus v. Phaneuf, 166 Mass. 123, 44 N. E. 141, 32 L. R. A. 619.
Missouri.—Burnett v. Freeman, 125 Mo. App. 683, 103 S. W. 121. See also Burnett v. Freeman, 134 Mo. App. 709, 115 S. W. 488.
New York.—People v. Montgomery, 13 Abb. Pr. N. S. 207.
Texas.—Summers v. State, 5 Tex. App. 365, 32 Am. Rep. 573.
Wisconsin.—Philler v. Waukesha County, 139 Wis. 211, 120 N. W. 829, 131 Am. St. Rep. 1055, 25 L. R. A. N. S. 1040 and note, 17 Ann. Cas. 712 and note.
Canada.—Guinea v. Campbell, 22 Quebec Super. Ct. 262.

See 50 Cent. Dig. tit. "Witnesses," Section 65.

"Retainer," as used in an agreement to pay a retainer to an expert witness and a per diem sum for the time he is engaged in the case, means a sum paid to secure the services of the witness, and is due as soon as the witness accepts employment, independent of any future work or its results. Hough v. State, 68 Misc. (N. Y.) 26, 124 N. Y. Suppl. 878.

Failure of witness to prepare himself and testify.—An expert witness is not entitled to the agreed compensation for his services, where his employment is dependent upon his being able to appraise certain manufacturing plants, and testify to a certain value therefor, where he fails to make such an appraisal and testify to such value. Hough v. State, 68 Misc. (N. Y.) 26, 124 N. Y. Suppl. 878.

If such services are performed without an express promise of compensation, extra compensation may be recovered upon an implied promise. Tiffany v. Kellogg Iron Works, 59 Misc. (N. Y.) 113, 109 N. Y. Suppl. 754. See also Butler v. Toronto Mutoscope Co., 11 Ont. L. Rep. 12, 6 Ont. Wkly. Rep. 527, 5 Ann. Cas. 992. But compare Fonda v. Bolton, 6 N. J. L. J. 240.

SOME EXPERIMENTS ON THE PHOTOGRAPHIC MEASUREMENTS OF ROENTGEN RAY DOSAGE*

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THE measurement of dosage in roentgen ray therapy has come to be a very important matter owing to the increasing demands and the variety of apparatus which may be called into operation for this work. At present there are three methods in general use, namely, the use of platinum barium cyanide pastilles, the photographic measurement, and the direct measurement method. By direct measurement is meant using a purely physical specification which must include (a) the amount of current in milliamperes, (b) the effective voltage at which the tube is operated, (c) target-skin distance, (d) amount and kind of filtration used, (e) time of a single dose, (f) the frequency of repetition of dosage. There can be no question that, in the hands of properly trained operators and under proper electrical conditions, this method gives the highest degree of accuracy as regards the radiation delivered.

The purpose of the following experiments is to determine if the ordinary photographic paper is reliable enough to be used as a standard either for use as an independent measurement of dosage in therapeutic work, or as a check in connection with the direct measurement method.

In order to make the photographic method successful in the hands of the average practitioner, it is necessary to consider judicially both the advantages and disadvantages of the method, because it is fully as essential to know the limitations of a method as to know its possibilities. In this connection the following questions had to be considered:

(1) Are the papers now on the market of proper sensibility and of sufficient uniformity to be of value in this field?

(2) If they are not of sufficient uniformity, can a method be developed so that a given batch of paper may be standardized with a sufficient degree of accuracy and without undue loss of time to the operator?

(3) Will different types of apparatus under identical physical specifications as to current, voltage, distance, and time give the same photographic effect?

(4) How much change is caused in the photographic darkening by a variation of any one of these physical specifications on the same machine?

(5) What are the effects of change in concentration of developer, change in time of development, change in temperature of developer, as regards the reading?

(6) Finally, what is the relation between the indication of the paper within its proper range of sensibility and the x-ray dose?

Clearly the last question cannot be answered in a physical laboratory, but it is equally certain that it also cannot be answered unless the previous matters are carefully considered.

In the work here reported, the first question that arose was whether the available photographic paper would give the proper gradation and if properly handled would give sufficient accuracy of reading and certainty of results to warrant considering the matter. Several kinds of paper were tried and the one shown in the following figures was found to be the best as to gradation and sensibility. The strip shown in Figure 1 was made as a standard strip. The darkest portion on this strip received an exposure under conditions which would just produce an erythema dose if applied to the skin. Each succes-

* Presented at the Nineteenth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chattanooga, Tenn., September, 1918.

sively lighter portion received one-tenth less exposure, differing from its neighbors by one unit of radiation; that is, an exposure of 10 ma., 7-inch gap, 16-inch distance, 120 seconds, was given the darkest one, 108 seconds to the next, 96 seconds to the third, etc. The whole strip was then developed under conditions which were found to give the best results.

Having electrical conditions under control so that the work could be duplicated, a very considerable number of these strips were exposed. They were made at different times by different individuals and always with instructions as to care in manipulation. The degree of uniformity shown in these different exposures was very striking and all agreed within one shade when compared. This clearly proved that it is possible to reproduce results on a photographic paper with a high degree of accuracy, probably well within that required in the present state of our therapeutic knowledge.

The next matter to be studied was whether papers on the market were sufficiently uniform when sold under a given label to make a reliable dosage measurement with standardization in the laboratory. In these experiments only the two papers which were found to be of the proper sensitiveness were considered. Samples of these two papers bearing the same manufacturer's label were obtained from various

Fig. 1.

Fig. 2.

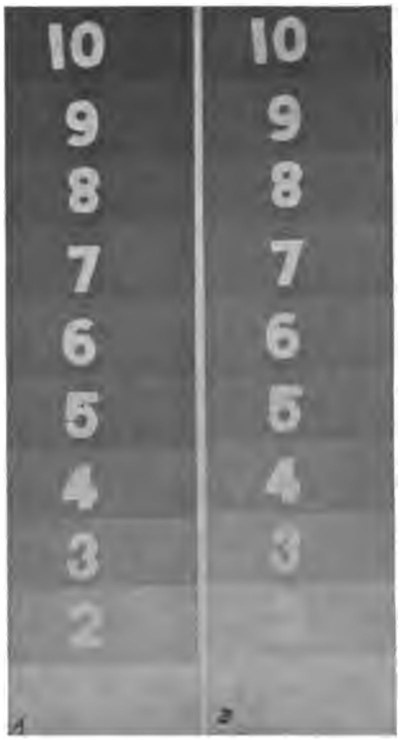

Fig. 3.

Fig. 1. Standard Strip. The exposure was made using 10 m. a., 7″ gap, 16 inches target-paper distance, No. 1 being exposed for 12 seconds, No. 2 for 24 seconds, 3 for 36 seconds, etc. The strip was developed under standard conditions using Nepera solution one part—five parts H_2O at 21° C., for one minute.

Fig. 2. Strips Showing Variation Caused by Different Types of Transformers. A, exposed, using an open core type and B, with a closed core machine. All other factors as to exposure and development were identical.

Fig. 3. The Two Strips Shown Above were Exposed and Developed under Identical Conditions. Strip A was under the cathode portion of the tube and strip B under the anode end, the strips being taken from both ends of an 8 x 10 sheet of photographic paper after it was exposed and developed.

sources, exposed, and developed under identical conditions. It was found that the discrepancy between sensibilities of individual lots of one of these papers was so great as to make its use an extremely area used in ordinary work. It was found that if an 8 x 10 sheet of photographic paper was exposed, the central beam striking the center of the paper, developed, and cut into strips, the strip nearest the

FIG. 4. THESE STRIPS WERE EXPOSED TO SHOW THE VARIATION CAUSED IN DARKENING DUE TO CHANGES IN VOLTAGE AS READ ON A HIGH TENSION, ELECTRO-STATIC VOLTMETER. THE VOLTAGE WAS VARIED FROM 45 K. V. TO 65 K. V. IN STEPS OF 5 K. V. FOR EACH STRIP. ALL OTHER FACTORS WERE CONSTANT FOR ALL FIVE STRIPS.

doubtful proposition. The second paper, Regular Carbon Velox, was found to be very uniform in emulsion and was the one used in the following experiments.

In exposing these strips, several interesting facts were noted. First, there is a variation in the amount of radiation in the cathode end of the tube is about one shade darker than the one nearest the anode end.

When using different types of machines under identical conditions as to spark gap, current, distance and time, and exposing strips, a difference of slightly more than one shade was seen on development. Two

types of transformers were used in this work. With the open core the strip was lighter than one exposed under the same conditions using the closed core type. On charting a curve of effective voltages as read on a high-tension voltmeter against spark gap reading, the explanation for this was easily seen. The effective voltage delivered by a closed core transformer is about 7 K. V. higher than that given by an open core type for the same spark gap reading.

Several strips were exposed, varying one condition at a time, such as current, voltage and distance, with the other factors constant. The result obtained agreed exactly with the law of photographic effect:

$$E = \frac{K. (V)^2. T. C}{(D)^2}$$

Another interesting condition noted was the marked decrease in the photographic darkening of the strip caused by the use of filters and that the greatest amount of the reduction is caused by the first third millimeter of filter. Aluminum was used as a filter and the insertion of one-third millimeter between the target and paper caused a reduction of practically four shades in darkening. The addition of a second one-third millimeter of aluminum caused a further reduction of only one shade in the photographic darkening. After the rays were filtered through one millimeter of aluminum it required the addition of another millimeter filter further to reduce the effect one more shade.

FIG. 5. THE EXPOSURE WAS THE SAME FOR ALL THESE STRIPS BUT THE TEMPERATURE OF DEVELOPER WAS CHANGED. THE TIME OF DEVELOPMENT WAS CHANGED SO AS TO GIVE THE SAME DARKENING. THE TEMPERATURE OF DEVELOPER WAS VARIED FROM 12.7° C. TO 29.3° C. INCREASING THE TEMPERATURE 4.1° C. FOR EACH SUCCESSIVE STRIP. FOR EACH INCREASE OF 4.1° C., THE TIME OF DEVELOPMENT WAS DECREASED 30 SECONDS, THE FIRST STRIP BEING DEVELOPED AT 12.7° C. FOR 120 SECONDS AND THE LAST ONE AT 29.3° C. FOR 60 SECONDS.

Having given a specific exposure to the emulsion on the paper, it then requires development, fixation, and washing before the final reading is obtained. It is well known that the same exposure might give

different degrees of blackening depending upon (a) nature of developing agent, (b) concentration of developer, (c) temperature of developer, (d) time of development.

The kind of developer as well as the concentration and time of development, when once determined so as to give the best results, can quite easily be duplicated. For this purpose, nepera solution was used in the proportion one part nepera solution to five parts water. The temperature found to give the best results was 21° C. The time of development, one minute.

In order to study the effects caused by changes in the various developing factors, several strips were exposed simultaneously and developed under different conditions. The first of these to be considered was concentration of developer. An exposed 8 x 10 sheet was cut up into five strips and each developed with developer of different concentration, all other factors being standard. The concentration was changed from one part nepera solution to three parts water to one part nepera solution to seven parts water. It was quite noticeable here that the effect is much more pronounced on the portions of the strips which were of greatest density, and the same is true to some extent as regards the strips in which the temperature of the developer was the variable factor. In other words, the effective change in blackening, due to an alteration in development, varies according to the exposure which the emulsion has received.

Next, the temperature of the developer was changed, other factors being standard. A variation ranging from 15° to 24° C. was used and it was found that the inference of dosage from these strips would be extremely erroneous, a difference of 2° C. either side of the standard, 21° C., making a difference of more than one shade on the finished strip.

The time factor was also studied and found to have a marked effect. Both the time of development and concentration of developer are conditions which may be easily controlled by careful manipulation. It is, however, very troublesome and difficult to bring the temperature to the exact point and keep it there unless special facilities, not usually found in laboratories, are provided. Inasmuch as a reasonably warm developer may give nearly the same gradation as a cooler one but in a much shorter time, the correct development time for different temperatures of developer might be determined to accommodate the variety of temperatures usually found in dark rooms. Experiments were performed to determine how much change of time was necessary for any given change in developer temperature to give accurate results. Strips which received the same exposure were found to compare exactly when developed under the following changes of temperatures and time: (a) 12.7° C. for 120 seconds, (b) 16.8° C. for 90 seconds, (c) 21° C. for 60 seconds, (d) 25.1° C. for 45 seconds, (e) 29.3° C. for 30 seconds. In short, twice the time of development is necessary for every decrease of 8.3° C. in the temperature of the developer to obtain the same photographic darkening.

From the results obtained in these experiments, it seems entirely possible that the ordinary photographic paper, having a uniform emulsion, may be used as a standard of roentgen ray dosage similar to that used in the Kienböck method. The paper used in the above work was Regular Carbon Velox and gives even a better gradation in the more dense portion of the scale than the one used by Kienböck. Considerable care is necessary in exposing such a strip to be used as a standard; but once this is done, strips of the same type of paper may be used as an indication of dosage, only being careful as to the factors of development. The method is one that might be used in any laboratory either as a separate method of measurement or as a check and record used in connection with the direct measurement method.

The work thus far studied deals only with unfiltered rays from a Coolidge tube operated on a rectified current. Later we hope to study in the same manner filtered

radiation and also measurement of radiation from the newer self-rectifying tube operated directly from the terminals of a transformer without a rectifier.

In conclusion, I wish to thank Lieutenant-Colonel Shearer for his most helpful supervision and advice throughout this work.

CASE OF TUBERCULOSIS OF THE INTESTINES WITH A DEFECT AT THE CECUM

BY PEER M. LUND, M.D.

NEW YORK CITY

PATIENT, a female seventeen years of age, suffering from pulmonary tuberculosis for the last three years was operated for appendicitis under general anesthesia about eight months ago. The appendix was found normal, but after the operation the general condition as well as the pulmonary symptoms became worse and the patient developed also a persistent enteritis and colitis, causing a very marked loss of weight and weakness. Tubercle bacilli were found in the stools.

Roentgen ray examination of the gastro-intestinal tract showed a very rapid emptying of the small intestines as well as of the colon, the barium-zoolak meal being in the descending and sigmoid colon three hours after the ingestion.

Fluoroscopic and radiographic examination of the colon by means of a barium-enema showed a definite filling-defect at the lower pole of the cecum and a general irregularity of the outline of the cecum and the ascending colon; there was marked tenderness in the right iliac fossa.

Operative findings were as follows: Tuberculosis of the transverse and ascending colons, cecum and ilium, with a large mass involving the junction of the distal ilium and the cecum; many small tubercles were seen on the large intestines.

Pathologists report, tuberculosis.

Operation.—Resection of the last 12 inches of the ilium, cecum, the ascending and part of the transverse colons.

REPORT ON A METHOD OF FLUOROSCOPIC EXAMINATION WITH THE ARMY BEDSIDE UNIT

BY F. F. BORZELL

Headquarters Base Hospital 38, A. E. F.

GRAND BLOTTEREAU, NANTES, FRANCE

THERE has been, perhaps, no one phase of war radiology which has attained such a field of usefulness as has bedside radiology, with the possible exception of localization of foreign bodies. Even the refinement and simplification of localization and removal of foreign bodies as developed by war necessities have to a great extent fulfilled their usefulness with the end of the war; but the development of bedside examination has opened a vast field for radiology. It is largely as an expression of appreciation of the value of the Army Bedside Unit that I am presenting this report.

During the last three months, which represents the actual time this hospital has been doing active service, we have examined a few more than 150 cases at the bedside.

The examinations have been radiographic with and without the intensifying screen and fluoroscopic, for fractures, foreign bodies and pulmonary conditions of those patients who could not be transported to the laboratory. One is often called upon to exercise every bit of ingenuity he possesses to secure two views to determine position. Stereoscopic studies have assisted many a time. With the aid of Bowen plate-

FIG. 1. FLUOROSCOPIC EXAMINATION AT BEDSIDE

holders, and by marking the horizontal sliding bar on the tube carriage, the required shift can readily be made.

Radioscopic studies have been made with the Dessane bonnet fluoroscope for fracture position, foreign bodies and pulmonary conditions. I have found one method of examination for pulmonary conditions very valuable. We have had a number of patients who required radiologic studies to determine the presence of fluid, empyema, hemothorax, bronchopneumonia, lobar pneumonia, pericardial effusions, pulmonary abscess, subphrenic abscess or foreign bodies. Many of these patients were either too sick to be moved or even turned upon their side, or else by reason of being splinted and slung in Balkan frames, and other fearfully and wonderfully contrived devices, could not be moved.

FIG. 2. SHOWING METHOD OF TRANSPORTATION BETWEEN BARRACKS

By the use of four stilts, which, when placed under the legs of the bed, raise the bed twelve inches, I can drop the tube beneath the bed and fluoroscoping through the mattress secure very satisfactory information.

The bed springs of the regulation bed do not interfere materially with the study, due to the fact that, being some distance from the screen and a greater distance from the screen than the tissues to be examined, the mesh shadow is very much exaggerated and but few of the lines of the spring intercept vision. I found the average distance between spring shadows 20 cm. In the case of a search for foreign bodies a slight shift of the tube will shift the shadows of the spring.

By this method the patient is not at all disturbed, nor is the position of the fractured limb disturbed. Where the Balkan frame is used, the frame, which is lashed to the bed, is lifted with the bed and rests with the legs of the bed on the stilts.

Our hospital being of the barrack type, it is necessary to carry the bedside unit from ward to ward. This is readily accomplished by suspending the unit by the handles on a litter made of timbers of sufficient strength and fastened together by two crosspieces. The carrier was made in a few minutes by one of my men. It consists of two timbers 2″ x 3″, 5 feet long set 16 inches apart and held together by two crosspieces 3 feet apart.

CONCLUSIONS

Bedside examination by this method affords:

1. Easy access to the entire torso and limbs, fluoroscopically.
2. Patients can be examined who would otherwise be unavailable.
3. There is no risk to very sick pulmonary cases.

SAFETY PIN IN THE LUNG FIVE YEARS

BY A. F. TYLER, M.D., B.Sc.

OMAHA, NEB.

THE following case is of interest both because of its rarity and because of the pathology which had gone unrecognized until the patient was brought for roentgen examination.

HISTORY.—C. B., age ten years. When five years old the mother says he "swallowed a safety pin." Later she watched the passages but she never recovered the pin. She noticed that the boy wheezed for a time after the accident but did not give this any significance, for she thought that the pin had probably escaped her notice when examining the stool. Two years after swallowing the pin the child was taken with what was pronounced bronchial asthma. This condition has persisted until the time of our examination.

Physical examination showed the boy undernourished, with Harrison's groove present on the left side. Auscultation showed moist râles over the entire left chest. Percussion showed the whole left chest dull.

Roentgen examination showed the entire left lung radiopaque with an open safety pin resting point upward in the central portion of the left lung, probably in the bronchus.

Operative interference was refused by the parents.

A review of the available literature shows reports of many foreign bodies inhaled into the lungs, but few that have gone unrecognized for such a long period of time. R. H. Good advises roentgen examination in every suspected case, and early removal. Fiorini and Rossi report a case of foreign body inhaled into the left lung five years previously. They did a transpleural pneumonotomy, removing the foreign body, and the patient recovered. Telega reports a case of foreign body several years in the bronchus. Richards reports a case of a young man twenty-five years of age who had inhaled a foreign body when a child. The patient came complaining of a purulent expectoration. Blood examination pointed to a focus of infection, and roentgen examination revealed the foreign body, a tack, in the right bronchus. This was removed and the patient made a good recovery. Packard reports the removal of a fragment of tracheotomy tube from the lung six years after its inspiration. Walters reports the removal of a foreign body in the lung by bronchoscopy eleven years after its inspiration.

FIG. 1. Roentgenogram of the chest of patient aged ten years who had supposedly swallowed an open safety pin five years previous. Notice the pin resting in the central portion of the left lung, that the point rests upward and that the entire left lung is radiopaque.

The cases cited above are those reported in which the foreign body had remained in the bronchus or lung five years or more.

The greatest length of time was twenty years, the next eleven, the next six and another five years. In all of these cases marked pathological changes had taken place in the lung corresponding to the changes in the lung of the boy here reported. In the case reported by Richards, lung abscess had supervened, in the others marked consolidation of the lung with bronchial inflammation.

In the patient coming under my observation, the foreign body was an open safety pin which rested in the left lung, the point upward. Although operation was refused by the parents, I feel that transpleural pneumonotomy would be the operation of necessity, since bronchoscopic removal would be impossible. This case emphasizes the importance of Good's postulate that roentgen examination should be made in every suspected case and the foreign body removed as early as possible.

ACUTE INFECTIOUS ARTHRITIS FOLLOWING PNEUMONIA

BY PEER M. LUND, M.D.

NEW YORK CITY

MALE, Russian, age thirty-nine.

HISTORY.—Negative, until ten weeks previous to admission, when patient had pneumonia, complicated with a left-side pleurisy, lasting about five weeks. While convalescing from the pneumonia, about six weeks ago, he began to have pain in the right hip and lower extremity, but no swelling and only a very slight rise in temperature.

On admission the right hip was found red, swollen and very tender to touch.

Temperature was 102°.

W. B. C. 10,000.

Sputum.—Examined three times; found negative for tuberculosis.

Chest Examination.—Negative.

Clinical Diagnosis.—Acute infectious arthritis.

Roentgen ray examination of the right hip showed a marked destructive process of the upper part of the head and neck of the femur, with a slight upward displacement of the bone. The acetabulum was flattened out and enlarged in its upper aspect. There did not seem to be any recent focus in the hip, and there were

no signs of new bone production. There did not seem to be any distension in the joint.

Diagnosis.—Acute infectious arthritis.

A PRACTICAL METHOD FOR TESTING THE EFFICIENCY OF AN INTENSIFYING SCREEN

BY ROBERT T. MORRISON

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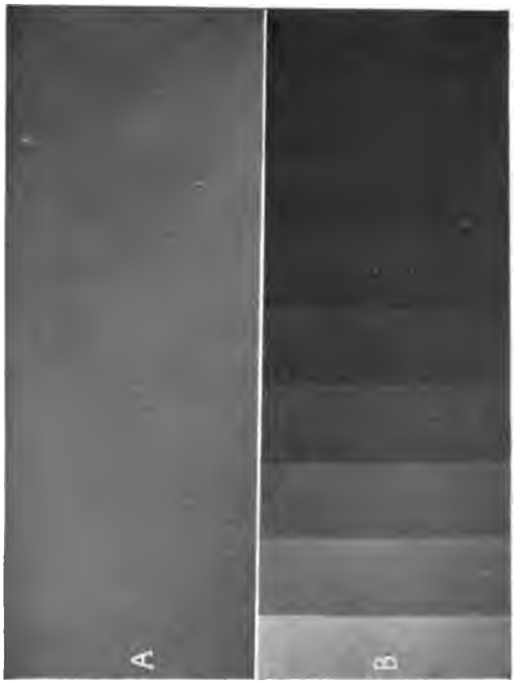
INTENSIFYING screens are not always found to have the same multiplying effect on exposure when used in the usual manner. There are a number of contributory causes to this result, namely, the wave length energy spectrum of the fluorescence, the volume of the total fluorescence and the wave length sensibility spectrum of the photographic material used. Speed, then, is dependent upon the coordination of these three factors and as such may be measured conveniently by a simple photographic method.

For some special work recently it was necessary to develop a method which was quick and at the same time reliable for testing the efficiency of intensifying screens under standard conditions.

The proof of the advisability of adopting any method of testing is governed by the accuracy of results weighed against the mechanical difficulties of measuring; further, if the process has few chances of leading to fallacious conclusions, the probable accuracy of the final result is greatly increased. The process here described was found to give satisfactory and reliable results.

In the present method a film or plate was placed in the cassette with the screen to be measured. One-half of the film or plate was "insulated" from the screen by means of black paper of sufficient opacity to prevent the fluorescence from affecting the sensitive emulsion, but not of sufficient opacity so that its roentgen ray absorption was of moment. A "unit exposure" was then determined, being that which just impressed a noticeable image on the plate. The half of the plate not covered by the black paper was then protected by a piece of lead. The remaining unprotected area was then given a series of exposures in one inch strips, increasing regularly in multiples of the unit exposure.

After exposing the last step, the half of the plate in direct contact with the intensifying screen was given one unit exposure. The plate was then developed under standard conditions. One-half of the material then showed a density resulting from the exposure to one unit with the screen and the other half showed densities ranging from one just noticeable to one nearly opaque. It was then a simple matter to match the density of the unit exposure with



A. UNIT EXPOSURE WITH SCREEN.
B. MULTIPLES OF UNIT EXPOSURE WITHOUT SCREEN.

the screen, with some particular step on the graded strip made without the screen. In the illustration given, this unit exposure with the screen matched step No. 3 on the graded strip without the screen. The screen

can thus be stated to have a speed factor of three since it requires three times the exposure without the screen to give the same density as with the screen.

For the purpose of the experiments in question, the unit exposure referred to was one second at 30 inches distance, 2½ milliamperes, 5 inch spark gap, using Eastman Dupli-Tized X-Ray Film, and standard developement was five minutes at 65 degrees in a standard Metol-Hydrochinon formula.

My thanks are due to Mr. Millard B. Hodgen for his helpful criticism and aid to suggesting improvements in the text.

THE ROENTGEN STUDY OF VISCEROPTOSIA *

BY P. L. ANSELL

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IN the roentgen study of visceroptosia, observance of several factors is necessary if one would avoid the common diagnostic errors of this disorder. A brief description of the most important features, together with a few illustrations, will serve to bring to your attention the value of roentgen ray study of this type of patient.

Constant observation of a great many cases and correlation of our findings with the accepted literature upon this subject forcibly bring out certain features.

First, that four major groups of bodily physique predominate, and that the majority of individuals can readily be placed somewhere in these groups. Stiller, in his extensive research work, has classified these groups as hypersthenic, sthenic, hyposthenic and asthenic.

Second, that each group shows certain characteristic proportional dimensions of thorax and abdomen with relative capacities, particularly of the upper and lower abdomen and pelvic cavities.

Third, that definite types of visceral form, position and tonus are fairly constant to each group. Schlesinger, in his research work on the stomach, has classified stomach as hypertonic, orthotonic, hypotonic and atonic, corresponding in the order named to the four types of habitus above mentioned.

Fourth, that morbid changes not infrequently complicate ptoses and one should be constantly on the alert for evidence of such change.

Group I, or Hypersthenic Habitus.—The general physical qualities of this group are massiveness of build; wide intercostal angle; thorax short, broad and deep; abdomen long, with relatively narrow pelvis.

FIG. 1. TYPE OF STOMACH COMMONLY SEEN IN GROUP 1.

Roentgenologically, we see a heart trans-

* Read before the Alameda County Medical Society in conjunction with a paper by Dr. H. Gordon MacLean.

versely placed, lungs that are short and broad at the bases and narrow in the upper lobes, a digestive system high in the abdomen and of quite marked tonus. The stomach is small, usually of the steer-horn type and transversely placed. Peristalsis and motility are fairly rapid. The emptying time of this type of stomach is from three to three and one-half hours and corresponds to Schlesinger's classification of hypertonus.

Very little of the small intestine is seen in the pelvic basin and the cecum is well up in the right iliac fossa. The colonic flexures are quite high, particularly the splenic flexure, which is frequently on a level with the fundus of the stomach. The transverse colon as it passes across the abdomen is most frequently above or on a level with the umbilicus and rarely more than an inch below that point. The haustra are small and numerous. The descending colon passes down the left side in a long sweep to the pelvis, and the sigmoid in the majority of cases is short. Twenty-four hour colon residue in this type is usually small and not infrequently the motor meal has entirely left the system at that period.

Group II, or Sthenic Habitus.—The physical qualities of this group are very similar to those of the preceding group, but with visceral characteristics tending toward the ptotic types. Physically, the thorax is longer and less broad and deep, the intercostal angle somewhat more acute and the abdomen is shorter.

Roentgenologically, we see a heart that does not differ greatly from Group I, but is somewhat more vertical. The lungs are longer and the difference between the upper lobes and the bases is less marked.

FIG. 2. TYPE OF STOMACH COMMONLY SEEN IN GROUP II.

FIG. 3. ANOTHER TYPE FREQUENTLY SEEN IN GROUP II BULBOUS TYPE.

The digestive plant is lower in the abdomen and of a different form. The stomach, while frequently of the tubular type, at times may be of the bulbous or fish-hook forms, and is more vertically placed with the lesser curvature varying from about one inch above to about two inches below the umbilicus. This type corresponds to Schlesinger's orthotonic type. Motility and peristalsis are not quite so rapid, although not infrequently they vary very little from Group I in these two features. The emptying time may be anywhere between three and one-half to four and one-half hours. The small intestine, colon and flexures are

usually lower and the haustra less numerous and more marked. Colon stasis at twenty-four hours is nearly always greater.

Group III, or Hyposthenic Habitus.—The physical qualities of this group are in marked contrast to the two preceding groups. Frail and slender physique, thorax long and flattened, long and narrow intercostal angle with a decided downward slope of the ribs, abdomen short and pelvic basin frequently broad and flaring.

Roentgenologically, we see a heart of the vertical type, lungs that are long and narrow at the bases and broad in the upper lobes, the digestive system low in the abdomen and frequently of poor tonus. The stomach, chiefly of the fish-hook type, is long and after the ingestion of an opaque meal appears partly collapsed in the *pars media*, sometimes markedly so, with the lower pole distended with the meal and the upper pole to a less degree by gas. The lesser curvature is usually below the interiliac crest line and often well down in the pelvic basin. Not infrequently in this type, the pylorus is ptosed, in some as low as the interiliac crest line.

The commonest location of the stomach in this type is the pylorus in the median line and about the level of the umbilicus, with the body of the stomach in the left iliac fossa. Peristalsis and motility at best are rarely as good as in the two previous types. The emptying time is between five and six hours, sometimes longer, depending upon the degree of tonus. This type of stomach corresponds to Schlesinger's hypotonic group.

The small intestine is mostly in the pelvis and the cecum frequently low in the pelvis and toward the median line; with the transverse colon commonly resting on the pelvic organs. Of all cases examined by the *x*-ray, this is the most frequent type seen.

Group IV, or Asthenic Habitus.—In this group we have all the characteristics of Group III, but to a more marked degree, less pronounced in the thoracic viscera than in the abdominal cavity and its contents.

This is the type referred to by Stiller as asthenia universalis congenita, and is the group most frequently suffering from symptoms.

Roentgenologically, we see a stomach markedly elongated, often dilated, of very poor tone, with the greater curvature often in the true pelvis. A six-hour gastric residue is not common although the emptying time is slower than in Group III. This type of stomach corresponds to Schlesinger's atonic group.

FIG. 4. TYPE OF STOMACH COMMONLY SEEN IN GROUP III.

The small intestine is largely in the pelvis and the ileum can be manipulated with difficulty, often not at all, with the colon correspondingly lower and usually spastic in type although in some the atonic type of colon is seen. A forty-eight hour residue is fairly common and not infrequently there is a seventy-two hour colon stasis.

While the foregoing classification of groups is generally accepted, there are still a few who adhere to a one-type standard by which they gauge ptosis and

that standard corresponding to Group IV. The fact that a great many patients with symptoms belonging to Group III and even a few in Group II have been relieved of their symptoms by treating them as enteroptotics should be sufficient evidence to disregard such a standard.

There is another type of ptosis in which the stomach is of fairly good position and tonus but with a pronounced prolapse of the colon. This type illustrates the necessity of a complete examination. Because the stomach is of fair position, it is unwise to discontinue the examination with the assumption that there is no ptosis. An interesting factor we have noticed in the great majority of ptotic individuals is that the head of the barium column reaches the sigmoid in normal time and frequently even in seventy-two hour stasis the entire colon is fairly well filled with the opaque meal.

The next important factor to be considered in connection with Groups III and IV, particularly Group IV, is a morbid change which may complicate ptosis. This factor is too often neglected in the presence of visceroptosia and many cases have been placed under treatment for visceroptosia with a temporary relief, but a recurrence of symptoms upon resuming their normal habits of diet. Especially is this likely to occur when an undiagnosed duodenal ulcer complicates the ptosis, as the necessary dietary to relieve the ptosis masks the ulcer symptoms, since most duodenal ulcer patients have no distress during the period in which food is in the stomach.

Gastric hypertonus, together with hyperperistalsis, should always be viewed with suspicion, particularly in Group IV, and careful search made for duodenal ulcer. If only moderate and transitory, search should be made for evidence of a chronic appendix or gall bladder disease. Many times apparent deformities of the pylorus and duodenal cap result from extreme ptosis and lack of tone. These deformities are most common when the pylorus and duodenal cap are of fairly normal position, but the stomach is of poor tone and quite low in the pelvis, with insufficient gastric contraction to force enough of the meal to

FIG. 5. TYPE OF STOMACH COMMONLY SEEN IN GROUP IV.

FIG. 6. ANOTHER TYPE FREQUENTLY SEEN IN GROUP IV. LESS ATONIC.

fill properly the pyloric antrum and duodenal cap. But with careful fluoroscopy and manipulation one can usually differentiate such deformities from those produced by gastric or duodenal ulcers.

Six-hour gastric residue, particularly if large, should always be viewed with suspicion, and careful search will usually be rewarded with evidence of ulcer, often situated at the pylorus. This is especially important when we consider Carman's report of some 250 cases of enteroptosis at the Mayo Clinics, in which 15 per cent were complicated by ulcer.

Not infrequently we fluoroscope patients with a visceroptosia and find evidence of gastric ulcer, the localized tenderness over the ulcer corresponding to McBurney's point and often leading to a diagnosis of appendicitis upon physical examination. In such cases the terminal ileum and cecum are usually much lower and a differential interpretation between ulcer and appendicitis, while clinically difficult without fractional analysis of the stomach contents, etc., can be made in most cases roentgenologically.

Terminal ileum stasis at twenty-four hours is rare in visceroptosia of any degree and its presence must be cautiously considered. If small in amount, spastic in type, in conjunction with localized tenderness in that region and in the absence of large six-hour gastric residue, it strongly points toward a diseased appendix. If large in quantity and not spastic in type and in the absence of large six-hour gastric residue, it points toward ileocecal valve incompetency, even if there is some localized tenderness. Ileocolic membranes and adhesions should also be considered and when possible ruled out.

Other conditions which do not come within the scope of the roentgenologist, only as they may involve adjacent structures, are inflammations of the pelvic organs which may result in adhesions to the ileum, cecum or sigmoid.

In routine examinations, nephroptosis is occasionally seen, chiefly right-sided and in some cases as much as three inches variation is noted between the supine and the standing positions.

Another very important feature is routine examination of the thorax. When one considers the type of thorax characteristic of Groups III and IV, no roentgen examination is complete until careful fluoroscopy of the lungs, heart and great vessels has been made and any abnormalities noted. Particularly should the lungs and mediastina be viewed for evidence of tuberculosis, enlarged glands or adhesions, all of which might have considerable bearing on the case.

CONCLUSION

The success of any rational treatment for visceroptosia depends primarily upon the clinician being reasonably sure he has no complications. That a percentage of failures is due to undiagnosed complications, there can be no doubt. A good history of patients unquestionably belonging to Groups III and IV, together with a careful roentgen study of the abdominal viscera, will do much toward decreasing the percentage of failures; and in the light of the foregoing factors, roentgen study of such cases should be rather the rule than the exception.

SOME EFFECTS OF ROENTGEN RAYS ON CERTAIN BACTERIA *

BY M. W. PERRY, M.D.

PHILADELPHIA, PA.

IN a recent comparative study of the immunity-producing properties of bacterial vaccines prepared in a number of ways, an unsuccessful attempt was made to sterilize a vaccine by roentgen rays.[1] This, with the modern use of the roentgen ray in so many diseases of bacterial origin, suggested the value of a review of the literature on the subject of the effect of roentgen rays on bacteria. And as a result of the review it was decided to do a few simple experiments in an attempt to clear certain points regarding which many conflicting reports were found. Among the earliest results reported on this subject are those of Reider[2] who, in a set of experiments which he later repeated, reported very marked bactericidal effects of roentgen rays. Rudis-Jicinsky[3] also reported positive bactericidal effects, finding that a number of organisms were killed in acid and alkaline media in glass with exposures varying from 35 to 60 minutes, with some variation of effect in media of different reactions. Since that time much work has been done on the subject and no single report confirms the findings already mentioned. Minck[4] found that bacillus tuberculosis on agar was not killed by exposure up to 64 hours. Blakie[5] found no effect on the same organism rayed in aluminum containers for 8 hours. Wilson[6] reported no effect on bacillus typhosus rayed through cotton plugs in test tubes one hour and a half. Bean[7] found no change in a number of bacteria from exposures of 10 to 60 minutes with all of the common roentgen ray tubes. Blaize and Sambuc,[8] Forbes-Ross,[9] Zeit,[10] and others have reported no effects on practically all of the common pathogenic bacteria by exposures much greater than the dose possible in the human.

As a result of this mass of evidence it has come to be regarded as rather definitely settled that roentgen rays have no direct effect on bacteria in inert media. Practically all of the manuals on the subject so summarize the matter. Yet it is common knowledge that carbuncles, boils, old ulcers, the pustules of sycosis, infected malignant growths and the like quickly become practically clean under roentgen ray treatment. And definite cures are claimed in chronic infections, as lupus and tuberculous adenitis. Stimulation of phagocytosis and increase of blood flow seem an inadequate explanation, as well-known means of promoting such fail to give the same definite results. Accordingly the question has arisen as to whether different effects are produced by roentgen rays on organisms in the tissues. And in this connection Lortet and Genaud[11] have reported that roentgen raying after inoculation of the inguinal region of guinea pigs with the tubercle bacillus prevents the development of tuberculosis in these animals.

The latest allusion to this subject is made by Newcomer,[12] who has found that "*X*-rays alone have a partial bactericidal action on water suspensions of bacillus typhosus." He worked by a method of plating, and the effects were reduction in numbers and never complete sterilization. This was an evidence of direct effect which had not hitherto been found.

Experiments were done with the following questions in mind:

1. Do roentgen rays kill bacteria in inert media in dosage comparable to the maximum dose therapeutically used in humans?
2. Do roentgen rays kill bacteria in living tissues?
3. Do roentgen rays render bacteria

* Read before the Undergraduate Medical Association, University of Pennsylvania, May 1, 1919.

more susceptible to killing by other means?

To determine the first point the following was done: Twenty-four hour boullion cultures of bacillus typhosus and staphylococcus aureus were smeared on the surfaces of agar Petri dishes, the covers replaced by sterile papers and one-half of each dish covered by a one-fourth inch lead plate. The plates were then roentgen rayed and incubated. Exposures of 40 and 60 milliampere minutes with the tube at a distance of 8 inches and with a 9-inch spark-gap and 3 mm. aluminum filters* gave no obvious difference in development of colonies on the exposed and unexposed halves of the plates. The same was true of exposures of 10, 15, and 60 milliampere minutes with a 3-inch spark-gap and no filters.

Following this, sterile squares of muslin were soaked in 24-hour boullion cultures of B. typhosus and staphylococcus aureus, and separate squares were placed in sterile Petri dishes. The covers of the dishes were replaced by sterile papers and the squares exposed. After exposures the squares were dropped in tubes of boullion and incubated. Exposures of 40, 60, and 120 milliampere minutes at a distance of 8 inches and with a 9-inch spark-gap and one glass filter did not kill the bacteria in any case. It was evident, as had been expected and in accordance with the literature, that roentgen rays in dosage even in excess of the maximum human dosage do not kill bacteria directly. (The maximum human dose under the conditions given above would be about 50 milliampere minutes with the glass plus 3 mm. aluminum filter.)

For the determination of point 2, as to whether a different effect was exerted on bacteria in living tissues, the following was done. The livers and spleens, and some of the lymph glands of two advancedly tuberculous guinea pigs were removed under sterile conditions and ground. To each gram of this pulp 100 c.c. of sterile saline were added and the whole filtered through sterile cotton, ½ c.c. of this suspension was injected subcutaneously in the left inguinal regions of nine guinea pigs. Four days later, before any signs of local glandular enlargements were evident, two of the pigs were roentgen rayed over the region of inoculation, one 50 milliampere minutes with a 9-inch spark-gap and at a distance of 8 inches, and the other for 25 milliampere minutes under the same conditions. One glass and 3 mm. aluminum filters were used to prevent burning in this and subsequent experiments, and all parts of all animals except the left inguinal regions were covered by a ¼-inch lead plate. The two animals developed local tuberculosis as rapidly as did controls. The roentgen rays in these therapeutic doses did not prevent the development of tuberculosis.

The other seven animals developed marked local glandular enlargements in twenty-one days. Five of these were then roentgen rayed under the conditions described above. Two were not roentgen rayed but taken as controls. Two were roentgen rayed 25 milliampere minutes, two 30, one 50, and one 75. Thirteen days later all pigs were killed and the left inguinal glands dissected out under sterile conditions. Cultures were made from each on Petroff's media and the glands were ground separately in sterile mortars with sterile saline and the resulting fluid injected intraperitoneally (1 c.c.) into nine other pigs. While there was some variation in the result of the cultures, in no single case did the inoculation fail to produce tuberculosis in the second set of animals. In other words, roentgen raying in the above therapeutic dosage did not destroy or prevent the growth of tubercle bacilli in local glandular lesions. Our results failed to confirm those reported by Lortet and Genoud.

The following table shows the results of the above animal tests.

For the determination of the third point, as to whether bacteria, although they could not be killed, were affected in some

* All filters were of the usual thickness of about 3 mm.

Pig	Inoc. left ing. reg. subcut.	Roentgen rayed Coolidge tube	Dose *	Autopsy 3/26	Culture of glands	Inoculation of suspension of glands
1	2/20	2/24	50 mam†	t-b		Positive t-b
2	"	"	25 "	"	Negative	" "
3	"	3/13	30 "	"	Positive	" "
4	"	"	30 "	"		" "
5	"	"	50 "	"	Positive	" "
6	"	"	50 "	"	Negative	" "
7	"	"	75 "	"	Positive	" "
8	"	Control	0 "	"	Positive	" "
9	"	"	0 "	"		" "

* *X*-rayed at a distance of 8 inches with a 9-inch spark-gap. One glass and 3 mm. aluminum filters were used.
† mam-milliampere minutes.

way whereby they became more susceptible to other influences, the following table will show; in doing these experiments twenty-four hour cultures were placed in wide mouthed cups and roentgen rayed through cotton plugs. All were roentgen rayed 60 milliampere minutes with a spark-gap of 9 inches and at a distance of 8 inches. One glass filter was used. Such a dosage corresponds to more than a full human dose. A part of each culture was retained as a control and not roentgen rayed. Both were then placed in a water bath at 56° C. and at definite intervals cultures were removed.

Heat at 56° C.	10	12.5	15	17.5	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45 Min.
Staph. *x*-rayed	+		+		+		+		+		−		−		−
" control	+		+		+		+		+		+		−		−
" *x*-rayed			+	+	+	+	+	+	+	+	+	+	+	−	−
" control			+	+	+	+	+	+	+	+	+	+	+	+	+
Typh. *x*-rayed	+	+	+	+	−	−	−	−	−	−					
" control	+	+	+	+	+	−	−	−	−	−					
" *x*-rayed	+	−	−	−	−	−	−	−							
" control	+	+	+	−	−	−	−	−							

From this table it seems that there is an increased susceptibility to heat produced by roentgen rays in dosage comparable to those used in humans. Possibly in the same way roentgen rays in the treatment of diseases of bacterial origin increase the susceptibility of the organisms to the defensive processes of the body.

CONCLUSIONS

1. Roentgen rays in human dosage do not prevent the development of B. typhosus and staphylococcus aureus on inert media. Roentgen rays in twice the human dosage will not kill cultures of the same.

2. Roentgen rays in human dosage do not prevent development of experimental glandular tuberculosis. Neither do they destroy the organisms in fully developed glandular tuberculosis.

3. Roentgen rays seem definitely to increase the susceptibility of B. typhosus and staphylococcus aureus to killing by heat. Possibly this may indicate a method by which therapeutic results are obtained in the roentgen ray treatment of bacterial conditions.

I wish to thank Dr. John A. Kolmer and Dr. H. K. Pancoast for the use of the facilities of the Departments of Immunology and Roentgenology of the University of Pennsylvania and for suggestions and advice. I wish also to thank Miss Katherine Stiner of the Department of Roentgenology for kind assistance.

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JEROME MCKAIG LEONARD

Dr. Jerome McKaig Leonard, Lieutenant M. C., U. S. A., age thirty-four, whose home was given as Douglas, Arizona, was killed in action in France November 8, 1918. Dr. Leonard, who was a graduate of the Hahnemann Medical College, Chicago, 1906, did excellent work as a roentgenologist in France. He was on duty for a while at the *x*-ray school in Paris, was later transferred to the 305th Field Hospital, 302nd Sanitary Train, 77th Division, for *x*-ray work with the Field Hospital. On account of changing tactics, whereby the Mobile Surgical Hospitals were brought closer to the front, Lieut. Leonard was temporarily detached from the Field Hospital and placed on temporary duty with the 307th Infantry of the same division, to which regiment he was attached on the date of his death.

JAMES T. CASE

TERMINOLOGY

Now that the great world struggle is at an end, roentgenologists in general and THE AMERICAN ROENTGEN RAY SOCIETY in particular are confronted by a problem that was considered settled several years ago. This is the question of terminology. Many years ago the *x*-ray men of Germany and Austria adopted the prefix "roentgen" in connection with all words applicable to the use of *x*-rays. Like all other forms of German propaganda, if this may be considered in the same light, the custom spread to Great Britain and perhaps to France, and finally we American *x*-ray men concluded that we were not abreast of the times unless we became roentgenologists and used the prefix "roentgen" in connection with all words implying the use of *x*-rays. Those of us who recall the adoption of this terminology will doubtless remember that considerable pressure came from the direction of the American Medical Association.

There seems to be a disposition on the part of some of our members to drop the prefix "roentgen" and substitute another, such as "radio." There is much to be said on this subject pro and con.

There is no doubt that we should have uniformity in literature, at least in the English language. Our allies in Great Britain dropped the prefix "roentgen"

immediately after the onset of the war, and are not likely to adopt it again. At least these two great English speaking nations should use a uniform nomenclature. There is no reason why we should go back to methods of Teutonic origin, and in fact there was no reason in the first place for adopting their terminology, which was in an entirely different language. No doubt the French roentgenologists would be willing to adopt if possible a nomenclature corresponding to ours.

While we can afford to a certain extent to be independent as an organization, it would seem futile to coin new words or employ words new to us that would not be acceptable to the American Medical Association. It would mean a change of terms from articles in our own Journal to those insisted upon by the American Medical Association when the same or a similar article was published in the Journal of the A.M.A. It would certainly create confusion throughout medical literature, in this country at least.

It would seem wise, therefore, for us not to be too hasty in making changes in the present nomenclature. We should certainly consult our British confrères and decide together upon a uniform terminology, and then approach the American Medical Association as the entering wedge into American medical literature.

The use of radium has reached such proportions as to make a special terminology essential in connection with its use as a therapeutic agent. There is much to be said in favor of a special terminology applicable to the use of radium, and the prefix "radio" may be the one best adapted to this purpose.

H. K. PANCOAST.

TRANSLATIONS & ABSTRACTS

BROWN, LAWRASON, M.D., and SAMPSON, HOMER L., Trudeau, N. Y. The Early Roentgen Diagnosis of Ulcerative Tuberculosis Colitis. (*J. A. M. A.*, Vol. 73, No. 2, July 12, 1919.)

[On account of the great importance of this question the editor takes the privilege of reprinting all that the authors say concerning the roentgen aspect of the question, together with the tables.]

For some years, the medical profession has had at its beck and call a technic which discloses the variations in the motility and contour of the large intestine. It is rather curious that so few have made use of this procedure in the study of tuberculous colitis. So far as we are aware, the first to call attention in American literature to hypermotility of the cecum was Pirie, who, after carrying out work suggested by Archibald, wrote a paragraph in the article by Archibald already referred to. He states that in tuberculosis of the cecum he was never able to visualize the barium meal in the cecum and was greatly disappointed. By careful observations repeated at half hour intervals and continued for from four to twelve hours, he was able to show that the tuberculous cecum retained none of the barium meal which normally should have accumulated there. He

TABLE 1.—POSITIVE CASES*

Case	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
							Il	Ce	HF	TC	DC	R	Spasm	C	HF	TC	DC	R		
4909	FA	3	+	33	....	Fav.	+	Sl	..	..	..	..	Ce	o	o	o	+	+	......	2, 5, 7
5045	FA	3	+	40	....	Fav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	Ce-HF	7
6867	FA	..	+	60	....	Fav.	o	Sl	+	+	+	..	Ce	†	..	..	..	..	o	
7162	I	2	o	3	....	Unfav.	o	Sl	+	+	+	..	Ce	Sl	Sl	Sl	Sl	Sl	....	3, 5, 6, 7, 8
7348	FA	3	+	30	....	Unfav.	+	..	..	..	..	..	....	o	o	o	Sl	Sl	....	2 and 5 questionable 7 and 8 persistent
7366	FA	..	+	36	Nephritis	Unfav.	+	Sl	..	..	..	..	Ce	†	..	..	..	..	......	2, 3, 5, 7, 8 persistent
7541	FA	..	+	14	....	Unfav.	+	Sl	+	+	+	..	Ce	o	o	o	Sl	+	......	3 severe, 7
7521	MA	3	+	24	....	Fav.	+	Sl	+	+	+	..	Ce	o	o	o	o	o	Ce?	1, 3, 6
7541	FA	..	+	8	....	Unfav.	+	+	o	+	+	..	HF	o	o	o	o	Sl	......	1, 3, 4, 6, 7
7561	MA	..	—	12	Larynx	Unfav.	+	Sl	+	+	+	..	Ce	o	o	o	o	o	o	1 persistent
7607	FA	..	+	13	....	Unfav.	Sl	+	o	o	o	+	Ce-TC	o	o	o	o	+	......	1, 4
7724	FA	..	+	6	Elbow	Unfav.	+	+	+	o	o	+	TC	o	o	o	o	o	o	1 and 7 persistent, 5, 8
7739	MA	3	+	10	....	Fav.	+	?	..	..	..	..	Ce ?	o	o	o	o	+	o	1 and 6 alternately
7805	MA	..	+	14	....	Unfav.	+	Sl	o	o	o	Sl	Ce	o	o	o	o	+	......	1 and 6 alternately, 2, 3, 4, 5, 8
7806	I	3	+	24	....	Fav.	+	+	o	o	+	..	Ce	o	Sl	o	o	+	o	1, 4, 7
7822	MA	..	o	18	....	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	+	+	Ce	1, 2, 5, –3 severe
7875	FA	..	+	9	....	Unfav.	+	..	..	..	..	..	....	o	o	o	o	o	......	1, 3
7901	FA	3	+	36	....	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	Ce	1
5075	MA	2	+	9	....	Fav.	+	+	+	+	+	..	Ce	Sl	Sl	o	o	Sl	Ce	1
8544	FA	3	+	6	Larynx	Unfav.	..	..	..	..	..	..	....	o‡	o	o	o	+	Ce ?	6, 7
8593	MA	3	o	12	....	Unfav.	+	+	..	..	..	..	Ce	+	+	o	o	+	......	1, 3, 8, –7 severe
8873	I	3	o	14	Appendectomy	Fav.	+	+	Sl	Sl	+	..	Ce	o	o	o	o	+	Ce ?	1, 2, 3, 7, 8
7093	FA	3	+	36	....	Fav.	+	+	+	+	+	..	Ce-TC	o	o	o	o	..	Ce-TC	1 and 6 alternately
7733	FA	3	+	36	Larynx, ear, rectal abscess	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	......	1, 3, 4, 8
8985	MA	..	+	12	....	Fav.	+	..	..	..	..	..	Ce	Sl	+	..	..	..	......	3, 6, 8
5058	MA	3	+	10	....	Fav.	+	+	+	+	+	..	Ce	o	o	o	o	o	Ce	1, 2, 3, 4, 8
9307	FA	3	+	..	....	Fav.	+	o	+	o	+	+	Ce	o	o	o	o	o	......	1, 4, –7 marked
5096	FA	3	+	7	....	Fav.	o	o	o	o	+	+	......	o	o	o	o	o	Ce ?	1, 2, 4, 8
4876	FA	3	+	5½	....	Fav.	+	+	+	+	..	..	Ce	Sl	+	+	+	+	......	4, 7
9508	FA	3	+	..	....	Fav.	+	Sl	o	Sl	Sl	+	Ce-HF	o	o	o	o	o	......	1, 2, 3, 5, 7

* Key to Characters, Numbers and Abbreviations: Pulmonary condition: N, negative; D, doubtful; I, incipient; MA, moderately advanced; FA, far advanced. Roentgen classification: Pb, peribronchial; 1, an area of parenchymatous infiltration including to the superior margin of the first chondrosternal junction on one or both sides, or, to the superior margin of the second chondrosternal junction on one side; 2, greater than 1; an area of parenchymatous infiltration including to the superior margin of the second chondrosternal junction on one or both sides or, to the superior margin of the third chondrosternal junction on one or both sides, or, to the superior margin of the third chondrosternal junction on one side; 3 includes anything greater than 2. Tubercle bacilli: +, positive; o, negative; blanks, no records. Six and 24 hour examinations: Il, ileum; Ce, cecum; HF, hepatic flexure; TC, transverse colon; DC, descending colon; R, rectum; Sl, slight; +, barium present; o, barium has passed this site; the blank spaces indicate the head of the barium column has not reached these sites. Abdominal symptoms: 1, diarrhea; 2, nausea; 3, pain; 4, indigestion; 5, vomiting; 6, constipation; 7, nervousness; 8, gas.

† No examination.
‡ Twelve hour examination.
§ Eighteen hour examination.

based his conclusions on a study of about twelve of Archibald's twenty-seven cases.

It was quite natural that we should have undertaken the study of this method of early diagnosis, as so many suspicious cases came under our observation. After our work was nearly completed, we discovered that in 1911 Stierlin[1] of Basel studied six such cases, in which later operation was done by Wilms. In these cases the absence of barium or bismuth shadows at certain times in certain sites, when normally they should have been present, suggested hypermotility. Stierlin diagnosed on this fact the presence of ulceration of the large bowel at the site which threw no shadow. In six such cases of tuberculous colitis and in one of chronic nontuberculous ulceration, Stierlin's diagnosis was confirmed at operation.

Several years ago, it occurred to us that the only treatment of tuberculous enteritis that promised much relief, or even suggested the possibility of cure, was surgical intervention,

TABLE 2.—NEGATIVE CASES

Case	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
							Il	Ce	HF	TC	DC	R	Spasm	Ce	HF	TC	DC	R		
4716	MA	1	+	18	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	4
4743	MA	Pb	+	21	....	Unfav.	+	+	+	..	..	..	o	+	+	+	+	..	....	2, 5, 6, 7, 8
4768	MA	1	o	13	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	..	....	2, 4, 5, 6, 7
4773	MA	1	–	8½	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	2, 4, 6, 7
4774	MA	Pb	–	48	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	2, 5, 6, 7
4777	MA	Pb	+	42	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	1, 3, 4
4785	MA	Pb	–	8	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	6
4787	D	Pb	o	18	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	1, 2, 4, 5, 7
4803	MA	1	–	10	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	4, 6
4810	MA	2	+	12	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	4, 6
4814	D	Pb	o	24	....	Fav.	+	+	+	..	..	..	o	+	+	+	+			
4817	D	Pb	o	36	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	4
4818	MA	1	o	9	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2, 4, 6
4783	MA	2	+	8	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	2, 4, 5
4824	I	Pb	o	24	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	....	4, 6
4827	MA	3	+	6	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2
4829	D	Pb	o	6	....	Fav.	+	..	..	..	..	..	o	+	+	+	+	+	....	2, 4, 6, 7
4839	MA	2	+	16	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	4, 6
4846	MA	2	+	27	....	Fav.	+	+	+	+	..	..	o	+	+	..	..	..	....	2, 3, 5, 8
4852	MA	1	o	14	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	2, 4, 5, 6
4878	MA	1	+	5½	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	6
4887	MA	Pb	o	4	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2, 4, 6
4894	D	Pb	o	16	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2, 4, 5, 6
4905	N	Pb	o	65	....	Fav.	+	+	+	+	+	..	o	+	+	+	+	+	....	4
4895	MA	3	+	6	....	Unfav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2, 5, 6
4907	MA	1	o	72	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2, 4, 5, 6, 7
4916	MA	Pb	–	6½	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+		
4920	MA	2	+	30	....	Fav.	+	+	+	..	..	..	o	+	+	+	..	..	....	4, 6, 8
4921	N	Pb	o	18	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	2, 6, 7
4922	MA	2	o	20	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+		
4940	MA	1	o	10	....	Fav.	+	+	+	..	..	..	o	+	+	..	..	..	....	2, 4, 6
4942a	MA	2	+	19	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	4, 6
4943	MA	2	+	4	....	Unfav.	+	+	+	..	..	..	o	+	+	+	+	+	....	2, 4
4953	MA	3	+	14	....	Fav.	+	+	+	..	..	..	o	Sl	Sl	+	o	+		
4978	MA	1	o	120	Addison ?	Unfav.	+	+	+	..	..	..	o	+	+	+	..	..	....	2, 4, 6
4998	MA	2	+	4	....	Fav.	Sl	+	+	+	..	..	o	+	+	o	o	+	....	2, 3, 4, 5, 6
5007	MA	3	+	72	....	Fav.	+	+	+	+	..	..	o	Sl	Sl	+	+	..	....	4, 7
5024	I	Pb	o	72	....	Fav.	+	+	+	+	..	..	o	+	+	+	o	o		
5042	MA	1	o	96	....	Fav.	+	+	+	..	..	..	o	+	+	+	..	..	....	2, 4, 6, 7
5080	I	1	+	12	....	Unfav.	+	+	+	..	..	..	o	o	+	+	+			
7505	D	Pb	NS	48	....	Fav.	Sl	+	+	..	..	..	o	Sl	+	+	o	o	....	3, 6
7681	MA	2	+	11	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+		
7770	N	?	o	1	....	Fav.	Sl	+	+	Sl	Sl	..	o	Sl	+	Sl	o	+	....	3
7977	I	2	NS	6	Epidid. ?	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	....	3
5037	MA	2	o	6	....	Fav.	+	+	+	..	..	..	o	+	+	+	o	+	....	2, 4, 5, 7
8526	I	2	o	14	....	Fav.	+	+	+	+	..	..	o	+	+	+	o	+	....	8
8551	MA	2	1	22	....	Fav.	..	..	..	..	..	..	....	+§	+	+	+	+	o	1
8559	MA	2	+	42	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	o	3
8792	MA	1	+	8	....	Fav.	+	+	+	..	..	..	o	+	+	o	o	+	....	8
8913	MA	2	+	18	....	Unfav.	+	+	+	+	+	Sl	o	..	..	..	..	..	....	2, 5, 6
9088	MA	2	+	156	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	1, 4
9207	I	..	o	60	....	Unfav.	+	+	+	..	..	..	o	+	+	+	o	Sl	....	8
9192	MA	3	+	6	....	Fav.	+	+	+	..	..	..	o	+	+	+	Sl	..	....	8
9141	I	..	+	96	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	1, 2, 3, 8
9106	MA	..	+	120	....	Fav.	+	+	+	+	+	..	o	+	+	+	+	+	....	4, 7
9105	MA	2	..	120	Effusion	....	+	+	+	+	..	..	o	Sl	Sl	o	o	+	....	1, 2, 3
4822	MA	1	+	5½	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+		
5065	MA	2	+	18	....	....	+	+	+	..	..	..	o	+	+	+	+	+	....	4
9227	MA	2	+	84	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	4, 8
9228	MA	2	+	24	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	....	4, 6

TABLE 3.—DOUBTFUL CASES

Case	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
							Il	Ce	HF	TC	DC	R	Spasm	Ce	HF	TC	DC	R		
4775	MA	3	+	30	....	Fav.	+	+	+	..	..	..	......	o	o	o	o	+	......	1, 2, 3, 4, 5
4780	MA	3	+	54	....	Fav.	+	+	+	..	..	..	......	o	o	o	o	o	......	6
4815	I	1	o	42	....	Fav.	+	+	+	+	..	..	Ce ?	o	o	o	+	+	......	4, 7
4881	MA	3	+	30	....	Fav.	+	+	+	..	..	..	......	+	+	+	+	+	Cecum	2, 3, 4, 6, 8
4902	MA	2	+	3	....	Fav.	+	+	+	+	..	..	Ce ?	Sl	Sl	Sl	Sl	+	......	2, 4, 5, 7
4908	MA	2	o	7	....	Fav.	+	+	+	+	+	+	......	o	o	o	+	+	......	2, 3, 4
4948	MA	Pb	o	36	....	Unfav.	+	+	+	..	..	..	......	o	o	o	o	+	......	2, 4
4955	MA	2	+	2	....	Fav.	+	+	..	..	..	..	......	o	o	o	o	+	......	4, 6
5000	MA	3	+	24	....	Fav.	+	+	+	+	..	..	......	o	o	o	o	+	......	4, 6, 7
7522	FA	..	+	36	Larynx	Unfav.	+	+	+	+	..	..	Ce ?	o	o	o	Sl	+	......	1 and 6 alternately
7529	FA	3	..	60	Appendectomy	Unfav.	+	Sl	Sl	..	..	..	Ce ?	Sl	o	o	+	+	......	1, 3, 4, 7, 8
7722	MA	3	+	18	Larynx	Fav.	+	+	+	+	..	..	......	o	o	+	o	+	o	1
7863	MA	..	+	24	Larynx	Fav.	+	Sl	o	o	+	..	......	+	+	+	o	Sl		
7877	FA	3	+	9	Larynx	Unfav.	+	..	..	..	..	..	......	+	+	+	..	..	......	......
8563	MA	3	+	42	....	Fav.	..	..	..	..	..	..	Ce ?	+‡	+	+	o	+	o	1
4544	MA	Pb	+	10	Larynx	Fav.	o	+	+	+	..	..	Ce ?	Sl	+	+	+	+	......	1, 3, 4
8942	MA	3	+	12	Otitis media	......	+	+	+	+	Sl	..	......	o	o	+	o	Sl	......	8
9206	MA	3	+	18	....	Fav.	+	+	+	+	..	..	Ce ?	o	+	+	+	o	......	6, 8
9135	FA	3	o	12	....	Unfav.	+	+	+	..	..	..	Ce ?	+	+	+	+	o	......	3, 6
7493	FA	3	+	20	Larynx	Unfav.	+	Sl	..	..	..	..	......	Sl	Sl	o	Sl	Sl	......	2, 3, 8, 1 and 6 alternately
7923	MA	3	+	48	Nephritis	Unfav.	+	+	+	+	+	..	......	Sl	+	+	o	o	Cecum	1, 3, 7,—8 marked

which led us eventually to discuss the subject with Archibald. For this reason, and because we have had an opportunity of seeing clinically and of studying roentgenographically some of the cases in which later operation was done by Archibald and by R. M. Brown, our interest in the subject has increased; especially is this true since we have been impressed with how little general medical practitioners and, for that matter, even specialists in tuberculosis, gastro-enterology, and roentgenology, know of the technic necessary to make a diagnosis of tuberculosis of the large intestine.

TECHNIC

The technic varies little from that used in most roentgen laboratories. The day before the examination the patient is requested to abstain from taking any laxative. At an appointed hour the next morning he is given a barium suspension on an empty stomach (formula: 1 tablespoonful of cocoa, 1 tablespoonful of sugar, 1 tablespoonful of flour, 4 ounces of barium, and milk to make 16 ounces). The examination during the ingestion of the meal has often been omitted, on account of the patient's condition. However, it is not usually of any importance in this work. Six hours after taking the meal, the patient is examined fluoroscopically and roentgenographically. This examination is important, as at this hour one should visualize the cecum and probably the ascending colon. An examination every half hour for the next hour or two may be necessary in order to catch the cecum partially or wholly filled. When possible, the patient is examined at the end of eighteen hours, but always at twenty-four hours. The eighteen hour examination may make the twenty-four examination unnecessary. Plates are absolutely necessary at all examinations. A day or two later, the patient, having taken an ounce of castor oil eighteen hours before, returns for a barium enema. The enema is administered by low gravity pressure, from 10 to 12 inches, and the injection is observed fluoroscopically. When the enema is seen to have reached the cecum or, as in many cases, has passed through the ileocecal valve, it is stopped and a plate is made in the prone position.

NORMAL MOTILITY

For convenience, we may say that the normal stomach empties itself in from three to six hours. The head of the barium meal reaches the ileocecal valve in from one to three hours. The ileum empties itself in from five to nine hours. The cecum is seen in from two to four hours after the ingestion of a meal. Six hours after the meal has been taken, the head of the column is seen at the hepatic flexure or the

splenic flexure. Complete evacuation of the meal takes place in from thirty-six to forty-eight hours. The cecum remains well or partially filled from the fourth to the thirty-sixth hour.

PATHOLOGIC HYPERMOTILITY

The first rather marked variation in the foregoing order of things to attract our attention was the rapidity with which the barium passed through the large bowel. Complete evacuation often occurred in from twenty to twenty-four hours, although it is not unusual, in a certain number of cases, to find a small amount of barium still in the rectum at the end of this interval. In many cases (usually the more positive), in six hours the head of the column could be seen in the sigmoid and rectum, while at the same time there was a small retention in the stomach. In view of the fact that the patients manifesting this hypermotility had not taken any cathartic for thirty-six hours prior to the examination, this rapid progress through the large bowel needed explanation. On closer observation, it was noticed in many of the cases that apparently the cecum or cecocolon was the seat of this definite hypermotility. A typical illustration is Case 7875. The six hour examination gave no trace of barium beyond the ileocecal valve; the terminal ileum was well filled. The nine hour examination disclosed faint traces of barium in the cecum and a fair amount around the hepatic flexure. This case would seem to indicate that the cecum and cecocolon refused to retain the material delivered to it and passed it along about as rapidly as it was received. In none of the cases later proved at operation to be tuberculous were we able to visualize a well-filled cecum or cecocolon, with the usual smooth haustral sacculations. It appeared as though the ulcerated portion of the bowel was unable to retain the usual amount of barium; or, indeed, it seemed to be completely emptied. In many of the positive and probable cases there was noticed a definite ileac stasis[2] at six hours with hypermotility in the cecum at subsequent examinations. Whether this apparent stasis was due to stricture, to spasm of the sphincter or to regurgitation, it is difficult to say. The last would seem to be very likely in many of the cases.

The question arose immediately: Could conditions other than ulceration of the cecum or of the ascending colon produce this rapid type of hypermotility with its peculiar attending features? A few control cases were examined after the administration of a cathartic (castor oil), and while there was an increase in rapidity of the passage of feces through the large bowel, the bowel did not present the same manifestations as are seen in those patients proved to have had tuberculous colitis. The former cases showed smooth haustration, and, while the contents moved along more rapidly than they did when not under the influence of the cathartic, a spastic or ragged contour was never visualized.

A few cases of acute or habitual diarrhea produced about the same manifestations as were observed in those in which cathartics were given. A study of an article by Jordan,[3] in which he illustrates a number of cases of colitis and diarrhea, fails to reveal any indication of the hypermotility observed in tuberculous colitis. From a study of the prints in articles by Imboden[4] and Spriggs,[5] it seems possible to exclude definitely disease of the appendix as the cause of these manifestations. George and Leonard,[6] in their book, apparently make no mention of such a picture as due to any other cause.

FILLING DEFECTS

The second, and probably the more important, manifestation observed was the spastic appearance of that portion of the bowel later proved to be involved, usually the cecum or cecocolon. The smooth haustral sacculations were absent and the bowel had a distinctly irregular and ragged appearance. In the positive cases the affected portions of the bowel were only partially filled. Under the fluoroscope, barium was seen to enter the diseased cecum; but a few minutes later it had passed on to the transverse colon. In some cases, while the abdomen was being palpated in the region of the ascending colon, the barium shadows were seen to move out of this portion of the bowel, even though no more barium had entered it, and *vis a tergo* could apparently be excluded. We have not been able to reproduce this particular manifestation in patients having apparently no tuberculous colitis.

STUDY OF BARIUM ENEMAS

In many of the cases we were unable to administer barium enemas, owing to the weakness of the patients, who, however, had usually a positive diagnosis. With the administration of the enema, in some cases, the barium was seen to move slowly, as a smooth mass, until it reached the suspected portion of the bowel, where it stopped. It was usually necessary to increase the gravity pressure in order to fill, in part, this portion of the bowel, which at times showed here and there irregular, string-like barium shadows, extending from the main column of barium into the portion of bowel we were attempting to fill. These manifestations suggested that the suspected portion of the bowel was in a state of spasm or collapse, and refused to receive the barium enema. By manipulation, however, it could usually be filled fairly well. In many cases, nevertheless, the filling was only temporary, for this portion of the bowel apparently developed a contraction or spasm, and the barium column was seen to move distally rather rapidly. In a few instances the ascending and transverse portions of the colon were emptied completely, producing a dilatation of the distal colon. The plates taken at this time which were considered to give positive evidence showed a definite filling defect in one or more portions of the bowel, usually the cecum or the cecocolon. So far, we have been unable to discover any condition, apart from intestinal ulceration, which produced this picture.

ANALYSIS OF RESULTS

In all, examinations were made in 110 cases. Three cases (2.7 per cent) were negative for pulmonary tuberculosis; six cases (5.4 per cent) presented only suspected pulmonary tuberculosis; eleven cases (10 per cent) exhibited incipient pulmonary tuberculosis; in sixty-eight cases moderately advanced pulmonary tuberculosis was present, and in twenty-two cases pulmonary tuberculosis was far advanced.

Among the negative and suspected or doubtful pulmonary cases there was no roentgenologic evidence of tuberculous colitis. In these groups, however, there were a few cases which showed a mild hypermotility.

Of the eleven incipient pulmonary cases, seven were negative; one gave doubtful roentgen findings; three gave positive findings. Of the last three cases, one was proved at operation; one patient died of pulmonary and intestinal tuberculosis(?); one patient is alive, and has not been operated on.

Of the sixty-eight moderately advanced pulmonary cases, forty-four were negative; fifteen, doubtful, and nine, positive. Of these nine, four were proved at operation, and five patients were not operated on.

Of the twenty-two far advanced pulmonary cases, none were negative; five were doubtful. Of these five, three patients were not operated on, and two are dead. Seventeen were positive. Of these seventeen nine were verified at operation; three ended with death; five patients were not operated on.

In many of the foregoing cases the operative findings tallied very closely with the diagnosis as to site and extent. The remainder, however, revealed more extensive ulceration than the plates or screen indicated. This can be readily explained by the fact that the barium remained such a short time in the diseased areas, particularly in the transverse and descending colon, that it was mere guesswork when these portions of the bowel were under consideration to confirm or exclude tuberculous changes. Then again, the motility of this part of the bowel would in all probability have to be studied at different hours. The lack of haustration would depend largely on the character and quantity of the barium visualized.

Through the kindness of Drs. Robert M. Brown, R. C. Paterson, S. F. Blanchet and Charles C. Trembley, we have been enabled to study roentgenographically some of their cases. It is interesting to note that in this second set of similar cases, the results were identical with those mentioned above.

We have intentionally omitted from this article any mention of the diagnosis of tuberculosis of the small intestine. So far as we are aware, no one has yet been able to diagnose definitely tuberculosis of the small intestine. This should always be borne in mind in suggesting operative measures. We have at present the problem under study and hope to arrive at its solution.

A number of cases classified as doubtful, which presented, on clinical study, all the typical symptoms of intestinal tuberculosis, revealed at the roentgen examination a fairly marked tendency toward hypermotility, which

was not sufficient, however, to enable us to regard it as a positive finding. Further, the cecum at the six hour examination (which usually extended over a period of at least fifteen to thirty minutes) never assumed its normal pouchlike appearance, but appeared more or less narrowed, or was distinctly incompletely filled, even though barium was seen distal to this site. The diameter of this portion of the bowel was apparently less than the diameter of the ascending and transverse portion. Normally, it may be recalled, the cecum is larger in diameter than any portion of the colon with the exception of the sigmoid and rectum. Furthermore, fluoroscopic examinations were necessary to confirm these data. The outline, while not typically ragged, did not reveal the smooth haustral sacculations normally seen. Finally, we would like to call attention to the fact that some of these cases were put in the doubtful group because we thought the plate might have been taken at a time when the characteristic appearance of the cecum was not present. Had we waited, a few minutes later we might have observed this portion of the bowel virtually empty. The enema plate, as a rule, with the possible exception that the cecal shadow was definitely narrower than the ascending colon, revealed no abnormalities. In a few of these cases operation has been done and they have been found tuberculous. Further, we would not like to assert that the absence of detectable hypermotility and filling defects absolutely excludes the possibility of tuberculous colitis. The presence of a beginning hypertrophic colonic tuberculosis may cause not only lack of emptying but even cecal retention at the end of twenty-four hours.

CONCLUSIONS

1. Tuberculous colitis can be diagnosed clinically with a considerable degree of certainty when the disease is far advanced.

2. On the other hand, in the early or latent stages, when remedial measures may prove of avail, the clinical picture may be of little aid in diagnosis.

3. In all stages, certain shadows cast by the barium meal at the end of six, eighteen and twenty-four hours determine definitely the presence of colonic ulcerations, but the absence of such shadows does not absolutely exclude colonic ulcerations.

4. The roentgenologic picture shows hypermotility and spasm, or filling defects.

5. The presence of such a picture in a patient with pulmonary tuberculosis should lead to a definite diagnosis of colonic tuberculosis.

6. Tuberculous colitis occurs far more frequently than hitherto supposed, and must be excluded in all advanced cases and in any early case with any abdominal symptoms, before submitting the case to radical treatment.

7. No examination of a patient with pulmonary tuberculosis can be considered today complete without a roentgenologic study of the intestine.

REFERENCES

1. Stierlin: München. med. Wchnschr. 58: 1231, 1911.

2. We considered ileac stasis present if, at the six hour examination, the following was observed: stomach seven-eighths or completely empty, ileum well filled, no barium having reached the cecum.

3. Jordan: Arch. Roentg. Ray 18: 328, 1914.

4. Imboden: Am. J. Roentgenol. 2: 582, 1915.

5. Spriggs: Lancet 1: 91, 1919.

6. George and Leonard: The Roentgen Diagnosis of Surgical Lesions of the Gastro-Intestinal Tract, Boston, 1915.

Constantin, Vigot and Gosselin. Immobility of the Cardio-Pericardial Shadow Considered as a Pathognomonic Sign of a Lesion of the Heart. (*J. de radiol. et d'électrol.*, Paris. February, 1918.)

The signs of wounds of the heart are of great variety, thus explaining the numerous errors of diagnosis and tardy or useless interventions. Fluoroscopy is of the utmost help in determining the necessity of intervention. The authors had under observation three cases of wounds of the heart (by small pieces of shell), complicated with hemopericardium, the effusion of blood being every time demonstrated by fluoroscopic examination.

The fluoroscopic signs of pericardial effusion are:

I. Augmentation of all diameters of the shadow of the heart.
II. Changes in the outline of this shadow.
III. A more or less complete disappearance of the rhythmic movements.

In cases of serous or purulent pericardial effusion the outline of the shadow of the heart is sometimes pulsatile.

The increase of the shadow may be due to a cardiac dilatation and is not a pathognomonic sign.

The deformation of the outline of the shadow of the heart has not a great value, as a wound of the lung may blur and change this outline.

The immobility of the outline of the shadow of the heart is a sign of first importance and its presence gives a certitude of a lesion of the heart. In two of the cases observed by the authors, the immobility was absolute, giving the impression, that "the heart had ceased beating." In the third case, there was a very slight undulation of the left border of the shadow, at the level of the left ventricle.

BÖDLER, LORENZ. A Case of Congenital Permanent Dislocation of the Patella. (*Ztschr. f. Orthop. Chir.*, Stuttg., 1918.)

A man, forty years of age, presented himself for rheumatic pain in the left lower limb, which from childhood was always weaker than the right. He started walking only at the age of six with the aid of a cane, which he discarded at nine. He could never keep pace with his fellows, his left leg tiring very quickly. Going down he has no difficulty, but stepping up requires effort and exhausts him. The left thigh is atrophied. The calves are about equal in size.

The site of the patella shows itself dislocated to the left during extension and flexion. The roentgen ray shows in the anteroposterior plate that the patella rests on the outer side of the left external condyle, almost sagittally, that is with a torsion of 90°. On the lateral plate the patella cannot be seen. When the knee is flexed, the patella slides so far back that it is completely covered by the head of the fibula.

In the extreme flexion an anteroposterior plate shows both condyles normally developed, the patella at 45° from the outer surface of the external condyle, just above the head of the fibula. Instead of its being almost parallel with the tuberosity of the tibia, it lies at an angle of 70°.

DOUGLAS. Carcinoma of the Stomach. (*Surg., Gynec. and Obst.*, 1919, XXVIII, 76. Ref. *Progress Med. Sci.*, p. 848.)

The conclusion reached by the pathologists of the Mayo Clinic, where probably more material from excisions of ulcers and early carcinomata are examined with the greatest care than anywhere else in the world, should carry great conviction, even considering the work of Bullock. The considerable but not tabulated reports in cancer in a small area of the edge of an old ulcer, is proof positive that the change does occur, confirming the above statement. The evidence that cancer develops from chronic irritation and ulcers in other localities, adds probability that the same metamorphosis occurs in the stomach. The agreement of those who are opposed to the theory of carcinomatous degeneration in a large percentage of ulcers that a previous ulcer history may be obtained in from 5 to 17 per cent together with the facts that diagnosis is not always certain, and that ulcers may perforate without previous symptoms, and that a long ulcer history is not contrary proof, would seem at least to make it a fair presumption that ulcer preceded cancer in a larger percentage of cases than their figures indicated. The results after gastro-enterostomy are the strongest presumptive evidence against carcinomatous degeneration of ulcers, but an explanation is not inconceivable, based on the rapid healing which usually occurs in ulcers near the pylorus after operation, and the theory of a possible inhibition of cancer formation after gastro-enterostomy, according to the theory of Gressot, on the possible digestion of sloughing carcinoma, and remembering the claim that a large percentage of cancers originate in ulcers does not mean that a large percentage of ulcers necessarily become malignant. The following facts are not contested: (1) The mortality without operation is 100 per cent; (2) the percentage of deaths from cancers of the stomach in the total death-rate is 1 per cent. (3) More than 30 per cent of all cancers occur in the stomach. (4) Of late years the statistics at the large clinics show an operability of 38 (Mayo) to 39 (Bloodgood) per cent of cases coming to the surgeon. Gastric ulcers are potentially cancer and a diagnosis macroscopically in the early stage of malignant development cannot be made; therefore, an old callous ulcer in a patient of the cancer age should, when possible, be excised. If small and not believed to be malignant, and only then, it may be destroyed by the cautery method, and a gastro-enterostomy done, or else a transgastric resection or pylorectomy performed

whenever it seems even possible that carcinoma has begun at any point in the margin of the ulcer.

STRONG. Polypoid Adenoma of the Uterus. (*Am. J. Obst.*, 1919, LXXIX, 502. Ref. *Progress Med. Sci.*, p. 858.)

One of the very frequent forms which tumors of the uterus take is that of polypus and it is not unusual to hear this term used as though it constituted a diagnosis of a condition. It is plain, however, that the word relates merely to external form and tells nothing of the structure and hence nothing of the nature of a tumor. There are a definite number of pathological conditions which may assume this form and these are generally not especially difficult of recognition in the gross specimen, so that it would be more satisfactory to speak of such tumors according to their specific class using the word "polypus" as a qualifying adjective, thus, "myoma polyposum," etc. What are perhaps most commonly meant when polypi of the uterus are spoken of are adenomata, either of the cervix or corpus uteri. These are tumors of common occurrence, but they have received rather scanty attention in text-books and reports, since their importance clinically has been considered to be slight. During the past five years there have occurred at the Woman's Hospital in New York City several cases where such polypoid adenomata have developed into malignancy of a type which appears to have striking individual characteristics. It should be noted that the polypoid form of these tumors is but a mechanical and secondary effect of the special region in which a tumor is produced and that it has no pathological significance in itself although it frequently does have a clinical significance which may be important, such as hemorrhage and necrosis, both due to interruptions in the blood supply. Pathologically, these tumors may be adenomata, myomata, carcinomata or sarcomata, or they may be an evidence of a simple polypoid hyperplasia of the uterine mucosa. Microscopically, the adenoma has in general all the characteristics that the hyperplasia has not, that is, the glands are irregular in size and outline, their cells show irregularities of arrangement and form and the relationships between gland and stroma are widely disturbed. The basal layer has the adenomatous changes as marked as the rest of the mucosa instead of the relatively simple glands of the normal basalis. According to Strong, there is no difficulty in recognizing an outspoken adenoma but the changes which separate it from simple hyperplasia are all relative and not absolute. The reason that uterine adenomata are polypoid is a physical one, namely, that they are surface tumors and represent non-invasive proliferations of simple glands, and the increase in bulk produced by the proliferation, being non-destructive of other tissue, tends to grow in the direction of least resistance, therefore, on a surface, the proliferation is outward.

BOGGS. Radium in Cancer. (*N. Y. M. J.*, 1919, CIX, 488.)

Skepticism in regard to the value of radium in the treatment of malignancy is rapidly disappearing on account of its extensive use and the brilliant results that have been achieved in many cases especially in epithelioma, fibroids and as a palliative measure in inoperable cancer. It is now generally agreed by the surgeons of the largest clinics that radium is a valuable adjunct in the treatment of malignancy. In some places it is used only as a palliative procedure while in other places it is also being used as an anti-operative treatment. In discussing this matter Boggs reminds us that several factors have brought radium into disrepute and have given the impression that the claims made were unjustified. Chief among these is allowing patients and the physicians who refer them to us to expect a permanent cure when only palliation and prolongation of life is all that any one with ordinary medical intelligence could expect. The patient often cannot receive much palliation from any other method of treatment, but by the use of radium will improve rapidly for a time, or even a clinical cure will be obtained. Finally, on account of the extensive metastases, the patient will die after from six months to three years or more of prolongation of life. Then those who were watching the case or those who knew that radium had been used, will decide that radium had no value, without remembering or knowing the condition of the patient when radium was started. If one is to express an opinion as to the therapeutic value of a remedy, such statements should be guarded unless a

study of all factors has been made and one should be without prejudice for or against the remedy. Many operators have used insufficient quantities of radium thus giving inefficient doses, or else, on the other hand, have overtreated the local growth, without attempting to treat the metastases. No one will deny that, under certain circumstances radium may be harmful rather than beneficial, since if the dose is too small or too long continued, stimulation rather than destruction may take place while, on the other hand, too large a dose may result in irreparable damage to normal tissues. Treatment of hopeless carcinoma in the past has been with morphin, but today the author believes that it should be by radiotherapy since it is pitiful that patients with inoperable cancer, after their condition is pronounced hopeless, receive so little consideration. However, he cautions that thorough knowledge of the action of radium is essential because from that knowledge only may the proper dose be applied to produce the best results and haphazard use of radium should be discouraged. In estimating the value of radium therapy, its advocates do not claim that it supersedes surgery, but that it is a valuable adjunct to surgery, in helping to prevent recurrences after operation and in rendering inoperable cases operable and that it has proved itself one of the best palliatives we have in cases in which operation is impracticable and in many of such cases has brought about an apparent cure. In recurrent and inoperable carcinoma of the uterus, Boggs believes that radium might be considered the specific treatment, because it is the only method which retards the process to the same extent and gives the same amount of palliation. Radium is always less valuable in recurrent than in inoperable carcinoma of the uterus and since so much has been accomplished in the inoperable cases, in every primary case, no matter how early the operation has been performed, Boggs believes that there should be either ante- or postoperative treatment with radium, or both.

Mantoux, Ch., and Maingot, G. Radioscopic Examination of the Lung and its Limited Sensitiveness. (*Bull. Soc. méd. d. Hôp. de Par.*, October 24, 1918.)

In the immense majority of clinical examinations of the thorax, auscultation and radiologic researches give on the whole quite comparable results.

Nevertheless, in some cases the diagnosis based upon both methods is not comparable. If the lesions are deeply located and separated from the ear by a deep layer of sound pulmonary tissues, they may be detected only by roentgen rays, while on the contrary some lesions perceivable with the ear are invisible with roentgen rays. Such are lesions developing in bronchitis and dry pleuritis and presenting no concomitant inspissating of the pulmonary tissues; lastly there are some tuberculous infiltrating lesions invisible on the radioscopic screen because of insufficient sensitiveness of the method.

Very small lesions are undetected by roentgen rays, as are the very fine details of bone structure. Below a certain extent and a certain thickness, the foci of tuberculosis infiltration are invisible on the screen.

The authors have determined experimentally the conditions of visibility of tuberculous lesions. The tests were undertaken with normal subjects of normal stoutness, and fragments of tuberculous tissues removed at necropsies.

The following results were obtained:

Fragments of tissues, 5 to 7 mm. thick and extending over several cm. square, gave shadows barely visible on the screen, as did also a fragment of infiltrated pleura, 15 mm. thick. A distinct shadow was obtained only with a fragment of ganglion 2 cm. thick.

None of these fragments gave visible shadows if examined through a stout person.

Thus the authors conclude that the nondetection of tuberculous lesions after a radioscopic examination does not prove with certainty that there are no pulmonary lesions or pleural alterations.

Major Bougourd, A Speedy and Inexpensive Process for Obtaining Radiographic Reduction on Bromide Paper. (*Bull. de Radiographie Militaire*, February, 1918.)

At the Laboratory of Radiography of the 37th Hospital at Granville a rapid and economical process for obtaining reductions of radiographic plates is used.

In front of a well-lighted window of which the pane has been provided with opaque glass,

a wooden frame meant to receive the intermediaries for the different sizes of the plates is placed.

At the proper distance is a small camera, 13 x 18 centimeters, with rectilinear objective and a focussing plate of ground glass.

After the plate is exposed on the window in its intermediary, the surface protected by black paper masks, the focus is taken according to the size of proofs required. It is rather better to use the diaphragm to get a greater accuracy of details, then the ground-glass plates are replaced by a masked frame holding, instead of sensitive plates, a sheet of rapid bromide paper protected by a glass plate to avoid creasing.

The time of exposure varies according to the intensity of the daylight or the strength of the plate, generally ten seconds for a normal photograph. It only remains to develop carefully. To avoid any blurring it is wise to mask the rest of the window with curtains or blinds.

This speedy and inexpensive process gives very clear reductions, and the quantity of bromide paper used is very small, sizes being 9 x 12, or 8 x 10 centimeters.

The reduced proofs can be added to the papers of a case, and will take the place of encumbering drawings or larger photographs.

They can also be used for collections in albums of small dimensions.

KIMURA. Effect of *X*-rays on Carcinoma in Vitro. (*J. Cancer Research*, 1919, IV, 95.)

Some experimental work with mouse tumors has been performed to determine the effects of roentgen ray irradiation on living carcinoma and sarcoma cells in tissue cultures *in vitro*. In the course of the research, it was found that mouse carcinoma and sarcoma grow as well in guinea-pig plasma to which has been added mouse serum diluted with Ringer's solution as in mouse plasma itself, and the outspreading growth of cells in culture, both sarcoma and carcinoma, was not stopped by roentgen ray action varying from E 4 to E 12. The mitotic figures of cells were limited to a minimum after an exposure of E 8; after exposure to E 12, however, they disappeared entirely and the treated tissue produced no tumor when inoculated into mice. The growing power of sarcoma after E 4 exposure was stimulated to some extent, while carcinoma was not appreciably influenced. After an exposure of tissues to E 12, both sarcoma and carcinoma, the growing power of these tissues was stopped when inoculated into mice, and eliminated the process of mitotic division of cells. The process of oxidation of tissues, both sarcoma and carcinoma, was stimulated by the roentgen ray action of E 4 and retarded by exposure to E 12 of the ray. The terms E 4, E 8, E 12 indicate that the Hampson's pastille used No. 8 or No. 12 tint, that is, equivalent to a dose ¼, ½, or ¾ of Sabouraud's B tint.

HOLWEG, H. The Combined Roentgen and Benzol Treatment of Leukemia (Zur kombinierten Behandlung der Leukamie mit Roentgenbehandlung und Benzol). (*München Med. Wochenschr.*, 1918, LXV., No. 44.)

So far, all attempts to cure leukemia either with roentgen rays or with benzol alone have failed. Neumann treated a case with benzol in which the number of leukocytes fell from 56000 to 5300 and the enlarged spleen was reduced to one-half of its original size. Though the administration of benzol was then stopped, the number of leukocytes went on diminishing until it reached 200 per c.c. After 39 days the patient died, but not of leukemia, but of benzol poisoning. Benzol must therefore be administered with caution.

The author applied combined roentgen and benzol treatment to a patient 55 years old. Splenic dimensions 28 x 12 cm. Hemoglobin 60 per cent. Red cells 3,340,000. White cells 148,750. Treatment: First once, then three and four times daily, of two capsules (.5 g. benzol and .5 g. olive oil) and roentgen treatment once a week. (25 minutes, 3 mm. aluminum filter, distance 30 cm., dose each time 5 Holzknecht). Treatment began Oct. 27, and continued four months. March 4, examination of blood: Hemoglobin 82 per cent; red cells 3,968,000; white cells 62000. Benzol was stopped December 22, when white cells had fallen to 37,100. Roentgen treatment was stopped January 3, when the spleen had reached the dimensions of 12 x 7 cm. At present the case is apparently cured.

OPITZ, E. On Highly Filtered Roentgen and and Radium Rays (Ueber stark gefilterte Roentgen und Radiumstrahlen). (*Med. Klinik*, Berlin, 1918, XIV, No. 38.)

The alleged danger of filtered roentgen rays has lately played a considerable rôle in medical literature. Cases of injuries to the intestines ending in death have been reported. These reports led Opitz to study this question more closely. Measured quantities of roentgen rays may produce irritation and tissue changes: 1. The biological effects of the rays depend on the quantity of the roentgen rays absorbed by the tissues. 2. It is within wide limits independent of the hardness of the rays. 3. The effect is greater if the dose is given at one sitting than if subdivided. 4. The effect of the same dose is greater if given with high intensity for a short time than if administered with low intensity for a long time.

The conditions which, in the deep application of the roentgen rays, produce the least injuries to the body with a favorable effect are as follows: 1. Great hardness of the rays (qualitative homogeneity). 2. Spacial homogeneity. 3. The largest possible field. 4. The smallest possible area of the exposed tissue mass. 5. Highest possible intensity. 6. Administration of rays at one sitting if possible. 7. Avoidance of ray crossing in superficial layers when several fields are treated. It is impossible to combine all these conditions as some of them interfere with each other. A medium procedure must therefore be adopted. The following has proved the most favorable: Focal distance from the skin, 50 cm.; size of field 15 x 15 cm., filtration by 1 mm. copper plate (in lean patients ½ mm. copper or 10 mm. aluminum). Administration of full dose at one sitting.

As a prerequisite for the application of hard-filtered rays it is necessary to know how much radiation is used. A proper measuring method must be applied. But so far only gauged iontoquantimeter chambers can be relied upon. Sabouraud pastils, intensimeters, etc., are of little value.

HAUDEK, M. Contribution to the Pathogenesis and Diagnosis of Gastric and Duodenal Ulcer (Ein Beitrag zur Pathogenese und Diagnose der Magen—und Zwölffingerdarmgeschwüre). (*München. Med. Wochenschr*, 1918, LXV, No. 32.)

An analysis of the roentgenological phenomena observed in gastric and duodenal ulcer leads the author to the following results: 1. In the early stages of all primary roentgen phenomena we meet with motor and secretory irritation phenomena which occur also without ulcer in purely nervous disturbances, so that the differential diagnosis is difficult and the question whether these irritation phenomena are produced reflexly by the ulcer or must be considered as primarily neurogenous, is undecided. 2. The stomach reacts to the induced irritation always with an increased contraction. The kind of reaction, or the form of the increased contraction, depends on the primary form of the stomach. The knowledge that the roentgenological ulcer symptoms are to a certain extent resultant phenomena from a disturbance in the vegetative nervous system, admonishes us to enlarge our limited knowledge in the field of pathology, especially of pathological histology. It will then perhaps be possible to replace the terms "nervous disposition," "neurosis," etc., by the names of well-defined diseases of the vegetative nervous system (centres or tracts, vagus and sympathetic nerve), or of the nerve endings, which manifest themselves primarily by irritation phenomena (stomach, intestines, heart, etc.).

LINDEMANN, W. The Significance of Mineral Metabolism in Radiotherapy (Ueber die Bedeutung des Mineralstoffwechsels in der Strahlentherapie). (*München. Med. Wochenschr.*, 1918, LXV, No. 38.)

A number of cases of death have lately been reported in Germany which were due to injuries of the intestines by the roentgen and radium rays. It is evident that the mineral metabolism may play an important rôle in such cases. In the metabolism of the body the salts of iron and calcium are the most important. In the gastrointestinal canal iron is dissolved out from its compounds and absorbed as a salt or ion. The place of absorption is the duodenum. At the same time a part of the iron of the body is constantly eliminated. This elimination is performed by the large intestine. Thus iron constantly enters and leaves the system. The same may be said of calcium. The results of physical researches into the roentgen rays show that even very slight quantities of metal in the intestinal layers may exert a special effect on the cells. In this respect the amount of iron in the intestinal contents must also be taken into consideration. It seems therefore probable that the iron in the intestinal wall and intestinal

contents dispose to injuries of the intestinal wall itself. In practice it would appear advisable to empty the large intestine by enemas and to avoid iron medication before applying the roentgen rays.

WINTZ, H. A Centering Device for the Roentgen Treatment of Cancer of the Uterus (Eine Zentrierungsvorrichtung für Karzinombestrahlung der Gebärmutter). (*München Med. Wochenschr.*, 1918, LXV, No. 38.)

In the roentgen treatment of uterine cancer exact centering is the most important point. Only by exact centering is it possible to attain the necessary 110 per cent of the standard skin dose for the destruction of the cancer. By the compression tube, used by Wintz, the cone of rays may be directed to any point. But it is not so easy, even for an experienced man, to hit the vaginal portion, resp. the uterus from any side. To make this possible Wintz uses a tube of dark glass, 2 meters long and closed at one end. In the closed end there is a luminous disk covered with a mass which produces a bright light even with hard roentgen rays. This disk stands obliquely to the longitudinal axis of the tube and rests on lead which, at the margin, rises slightly above the surface of the disk. The mass fluoresces as soon as it is hit in a straight line by the roentgen rays. Lateral rays or rays coming from below are cut off by the lead. This tube is laid into the vagina and pressed against the vaginal portion. In lateral exposure the tube is turned so as to meet the cone of rays.

HAMMER, G. The Roentgenological Methods of Determining the Size of the Heart (Die roentgenologischen Methoden der Herzgrossenbestimmung). (*München. Med. Wochenschr.*, 1918, LXV, No. 4.).

The various percussion methods in determining the size of the heart are frequently insufficient (as in emphysema, in fat persons, great enlargement of the heart, etc.). The possible roentgenological methods are: 1. Exposure to the roentgen rays at a distance (Ferndurchleuchtung and Fernaufnahme). 2. The orthodiagraphic methods (orthodiagraphy and orthoroentgenography). These methods give us only an outline, a silhouette of the heart, and not the spacial dimensions of the organ. But the outline obtained permits us to draw conclusions concerning the dimensions of an enlarged heart. For determining the outline of the heart only three lines are important: the distance from the median line on the left, the distance from the median line on the right, and the longitudinal diameter of the heart. Among the methods of determining the outline of the heart the orthodiagram takes first place. Numerous experiments showed that the values obtained by roentgenography at a distance were on an average 1 centimeter greater than the corresponding values of the orthodiagram.

SCAINI, N. Roentgen Treatment in Ophthalmology. (*Riforma medica*, Naples, 1919, XXXV, No. 5.)

In the normal eye the conjunctiva shows considerable sensitiveness to the roentgen ray, the eyelids and periorbital tissues are much less sensitive, and the other tissues of the eye, especially the retina and the lens, are relatively insensible to the roentgen light. The roentgen treatment is valuable in new growth of the eye. In epithelial tumors, especially of the conjunctiva, the effect of the roentgen ray is the more rapid and intense, the more recently the tumor has developed. The first applications are the most efficacious. Epitheliomas of the eyelids and of the internal angle of the eye are easily cured with roentgen light. Epibulbar tumors (melanosarcoma of the limbus) have also been successfully treated in this manner. In conjunctival diseases (trachoma and follicular conjunctivitis) the roentgen rays are not superior to the other methods of treatment, but in vernal conjunctivitis they bring surprisingly good results.

PUBLISHER'S NOTE

The strike of the printers and pressmen in New York City descended upon us at the precise moment when this issue was ready for the press. In the hope of a speedy settlement in a case where it seemed that the employers, who had already made many concessions to the unions in the past, were willing to meet their employees halfway with a fair and equitable adjustment of differences, we refrained from resorting to any of the expedients adopted by many other journals in this city.

We have been the more willing to wait, because the printing of The American Journal of Roentgenology requires an unusual degree of care, experience and skill in order that the reproductions of x-ray plates may show with absolute delicacy and fidelity the points which the authors wish to illustrate—and, frankly, we have been afraid to experiment.

But the time arrived when we no longer felt justified in further taxing the patience of our readers. Therefore, as an emergency measure, we have had the October number printed outside of New York City. If sucessfully accomplished, it may result in a permanent change.

We deeply appreciate the consideration shown by our subscribers and advertisers, and we ask that they exercise the same kindly forbearance as to any deviation from our usual style, or our high standard of workmanship in this issue of the Journal.

PAUL B. HOEBER,
Publisher

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THE TREATMENT OF MALIGNANCY BY COMBINED METHODS*

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A CURSORY survey of results obtained in the treatment of malignancy by using radium alone, or roentgen rays alone, or surgery alone, while disclosing the good features of each, points to the shortcomings of each method used separately, and leads to the conclusion that the successful physician of to-day can no more pin his faith to any single one of these agencies than can the generals of contending armies pin their hopes of victory upon the use of aircraft, artillery, or dreadnaughts alone; but just as the latter depend upon the proper coordination and cooperation of all agencies for the greater deterrent effect upon the enemy, so must the efficient practitioner combine every means for triumphal attacks on malignancy.

Radium is the most powerful form of radiation we possess when applied locally to the malignant growth. The value and limitations of radium when used alone or when applied with other agents must define its present place in medicine. In radium institutes it is being employed largely in the hopeless cases; and in many cases it is employed alone when better results would be obtained if combined with roentgen rays for extensive metastases, and with electric coagulation or surgery to remove necrotic or degenerated tissue. In private practice there are a few men who are using radium intelligently and conservatively; but a number are ultra-enthusiastic and apply it in every case of malignancy, regardless of the extent or nature of the disease.

Roentgen rays have been adapted in so many varied forms of practical uses, particularly in making diagnoses, that it is not surprising to find them used in other applications by persons entirely ignorant of their physiological action and unfamiliar with the clinical history of malignancy. Beneficial results obtained in this manner by a physicist or technician can be scarcely other than accidental.

Removal by the knife twenty-five years ago was considered the only legitimate method of treatment, regardless of the type, location or stage of the disease. If the patient was inoperable nothing was done, or else an operation was performed for palliation. But it is gratifying to note

*Read at the Third Annual Meeting of the American Radium Society, Atlantic City, June 9, 1919.

that all the better surgeons to-day realize that operation is seldom if ever indicated for palliation, that even in the early cases, cutting out the center of a malignant growth never retards but hastens its progress. A few careful observers even advise anti-operative radiotherapy, and nearly all are beginning to advise postoperative treatment.

There is no question that many cases have been and can be cured by the different methods singly; but usually the physician or surgeon in the past advised the method with which he was most familiar, instead of selecting the one or the combination that would yield the best end results.

Mastery of all forms of radiation is the first essential in efficient treatment of the various forms of malignancy. Each form of radiation has its place and has a decided advantage in its place. Radiation should not be used when operation is indicated, any more than a surgeon should cut out the center of a cancerous growth and expect radiation to do the rest. Such a practice brings both the surgeon and the radiotherapeutist into disrepute, because the profession is rapidly learning that each has his place.

Electric coagulation is a valuable method of removing tissue of low vitality which still contains more or less malignant tissue when the adjacent glands have been walled off by radiation. It also has the advantage over removal by the knife, in that the diseased tissue can be eradicated without opening the blood and lymph vessels. The chief advantage of destroying tissue by electric coagulation instead of by actual cautery or chemical agents is that there is so little inflammatory reaction produced, because the effect is not produced by the intensity of heat or chemical agent, but the tissue is destroyed by the resistance of high frequency current passing through.

Many contend that radiation from the roentgen tube and radium are the same thing; but we know this is only partly true. There is a difference in the physical properties between the two forms of radiation, as well as a somewhat different physiological action on both diseased and healthy tissue. In many instances, those using only the roentgen rays will say that all can be accomplished with this form of radiation that can be accomplished by both radium and the roentgen rays, while those who employ only radium may make a similar statement for this agency, or may even say that radium alone is superior in all cases where radiotherapy is indicated. Such statements show that the radiotherapeutist is not familiar with both forms of radiation and has not treated a large number of cases by both methods.

It is generally conceded that it is the rays which are absorbed in the tissues and the secondary radiation set up therein that produce the changes in the tissues. The difference in the physiological action between radium and the roentgen rays may be due to radium giving off beta rays, and because the gamma rays from radioactive substances set up more intense secondary or beta rays than from the roentgen tube. Without going further into the physical properties of each, it should be remembered that radium and the roentgen rays are closely related in their action on tissue, and should be discussed or considered together. Both forms of radiation have the so-called selective and inflammatory action on living tissue. Each will produce a destructive inflammation if given with sufficient intensity, but with radium a reaction of much greater degree can be produced without permanently injuring healthy tissue than with the roentgen rays. This is an important therapeutic difference between the two agents, and is very important in treating certain malignant conditions. Therefore radium can be used therapeutically with a greater destructive power locally than the roentgen rays, but great care must be exercised, particularly so if cosmetic results are desired.

In order to produce tissue changes, either by radium or the roentgen rays, it is necessary that sufficient quantities reach

the tissues to be treated, and do not destroy adjacent healthy tissue, or tissue through which the radiation must pass. When a tube of radium is brought in contact with the growth, a certain dosage will inhibit proliferation, and will finally cause necrosis of the cells nearest it, while farther away from the tube the same kind of cells may be only stimulated. Therefore there is a limit through which the rays can pass through healthy tissue, without producing destruction, and destroy malignant cells. It has been demonstrated that when radium is placed in contact with a cancerous mass, the malignant cells can only be destroyed from 2½ to 4 centimeters, or a little over 1 inch from the radium tubes. By cross-firing this can be increased somewhat, but will not take the place of the source of energy being placed at eight or ten inches.

Radiation to the depth of ½ to 1½ inches is usually sufficient to destroy most malignant growths, but it will not reach the outlying cells in the lymphatic glands. Deeper effects can be obtained by placing the source of energy at a distance from the mass to be treated, and by cross-firing. By placing the radium or the roentgen tube eight inches from the surface and treating through seven ports of entry, a tumor four inches below the surface will receive about the same amount of radiation the skin of any one area receives. Then, since most malignant cells are about two to five times more susceptible to the destructive action of the rays than normal tissues, it is possible to produce clinical retrogression of malignant growths, and even within the lymphatic glands at some distance from the surface, without destroying the overlying skin.

In some cases, by inserting radium into the growth, larger amounts of tissue can be destroyed; but we are well aware today that when a cancerous mass is opened, and not completely removed, it nearly always hastens metastases, the same as an incomplete operation. Therefore, I never advocate inserting radium into a cancerous growth unless the surrounding lymphatics have been thoroughly treated, and the cancerous mass at least partially walled off.

From a clinical standpoint, all things being equal, radium and the roentgen rays may be divided into two classes, namely, those in which a localized reaction is desired, when radium is preferred, and those in which large areas are to be treated, when the roentgen rays are preferred. In many instances radium should be used locally, while the adjacent lymphatics should be treated by the roentgen rays. The exact comparison of the two forms of radiation is extremely difficult, due to the wide difference in technic, and the wide variation of results reported by the various writers.

No tissue is unaffected either by the rays from radium or the roentgen tube, provided the intensity be sufficiently great, and the exposure sufficiently long. In general, the rays in small doses have a stimulating, and in large doses a destructive action. There is always a latent period after the application of the rays, or occurrence of changes in the tissues. The larger the dose, the shorter the latent period will be. Every kind of tissue acts in its own specific way. The gland cells will be destroyed by a dose which does not harm the cells of the connective tissue or the skin; in other words, the sensitiveness to the action of the rays varies with the type of cell, and this is what is meant by the selective action.

Diseased tissues are more easily influenced by the use of either radium or the roentgen rays than normal healthy tissues. The action of the rays varies considerably with the type of disease under treatment. It requires considerably less radiation to destroy sarcoma in the lymphatics than it does to destroy carcinoma. This could be illustrated by treating lymphosarcoma of the cervical glands, where there is a large mass, and in treating carcinomatous glands which have metastasized from the lip, tongue or throat. The large sarcomatous mass will disappear much more quick-

ly under the same amount of treatment than the small carcinomatous glands. The results obtained in the treatment of sarcoma of the mediastinum are very marked when treated with radium or the roentgen rays externally, in comparison with mediastinal involvement from carcinoma of the breast. If observed by roentgenograms, sarcomatous masses respond rapidly, while carcinomatous masses decrease slightly or the growth is only inhibited. There is often a difference in two patients with the same disease responding to the same amount of radiation. This has led to much confusion; and unless the radiotherapeutist is familiar with these facts he is very likely to make mistakes in drawing his conclusions.

As before stated, in treating four inches below the surface of the skin, it is necessary to give seven erythema doses through different skin areas in order to obtain an erythema dose four inches below the surface. Carcinoma will not be much affected unless this amount of radiation is given, while a sarcomatous mass would probably be reduced in size by from one-third to one-fifth of this amount of radiation. We know that many have reported excellent results by applying radium externally near the skin in sarcoma of the mediastinum, while the same results have not been reported in carcinoma, as too small amounts of the radiation would reach the mediastinum even with cross-firing, without permanent injury to the skin, unless the energy was placed at a distance in order to give almost a homogeneous ray three or four inches below the skin.

It is a rule, in the treatment of both carcinoma and sarcoma, to give as heavy a dose as the normal tissue will stand, and to treat the glandular tissue as far away from the growth as possible. It is also a well-known fact that epitheliomas of the rodent type respond to less radiation than those of the squamous variety. The fact that it requires so much more radiation to cure squamous epithelioma, and that the adjacent glands are so nearly invaded, is no justification for statements that this type cannot be cured by radiation. It is also true that an epithelioma situated on the mucous membrane is always more malignant in character than where it starts on the skin. Besides proficiency in the physiological actions of both radium and the roentgen rays, a careful study must be made of the pathology of the different types of tumors and the manner in which each spreads. Metastases from the earliest stages to the time the case is inoperable, and the manner in which the patient finally succumbs to the disease, must be carefully observed before a radiotherapeutist is qualified. For the purpose of description, malignancy is divided into superficial lesions, which do or do not metastasize; those in which the disease starts in a superficial organ like the breast and which have early and fatal metastases, and those in which the growth starts in the uterus and adjacent glands and metastasize both early and late.

Two types of epithelioma only will be considered, viz.: basal or rodent ulcer, which does not invade glands, but if left untreated eventually destroys everything in its way; and the squamous variety, which nearly always metastasize early and, unless entirely eradicated, always prove fatal.

Radium and the roentgen rays should always be considered first in treatment of epithelioma, because, when properly applied, practically all epitheliomatous tissue will disappear and there are fewer recurrences than by any other method. It is a perfectly legitimate method of treatment in proper hands, but it is a method liable to abuse if it is not restricted to its proper field.

Results obtained in the treatment of epithelioma of the lower lip by radium, supplemented by the roentgen rays, have proven equal or superior to those obtained by surgery. This is true in early as well as in advanced cases. Epithelioma of the lower lip is a serious condition, and radiation, when employed, must be given in such a manner as to destroy all cancer cells in

the local lesion and in the adjacent lymphatic glands. When so given, over 90 per cent of the early superficial cases are permanently cured without deformity, more advanced cases are cured, and hopeless cases receive retardation and palliation which cannot be accomplished by any other method.

It has been demonstrated that radium wil' destroy cancer with a definite degree of certainty when the tubes are in contact with the surface for a depth of from 2½ to 3 centimeters, and by increasing the distance of the radium the depth at which cancer can be destroyed is increased. The lip is never any thicker than this, and the efficiency can be increased by cross-firing, or by placing a tube on the outside, one on the inside, and one on the top of the lip, so that the entire diseased area of the lip receives the best form of radiation.

In treating epithelioma of the lower lip, it must be remembered that cancer cells are from two to five times less resistant than normal tissue, depending upon the type of the lesion. Squamous cell epithelioma requires from two to four times more radiation to eradicate the disease than the basilar form. A few years ago this fact led many to believe that the squamous or the more malignant form could not be cured by radium. The reason was that insufficient dosage was given, and that small fractional doses were ineffective. Neither did they treat the submental, submaxillary or deep cervical glands thoroughly. Experience of the past certainly justifies the conclusion that cutting out the center of a wide-spreading lesion does not diminish the age of the cancer; but, on the other hand, the remaining disease often appears to grow more actively as the result of operation, while destroying the growth locally by radium does not hasten the process in the glands. A cure is never obtained unless the disease in the lymphatics is completely eradicated.

Anyone treating epithelioma of the lower lip should make a careful study of the lymphatic glands and the manner in which they metastasize. The lymphatics draining the lower lip are the submental, which receive the lymphatic vessels from the chin and central portion of the lower lip, and the submaxillary receive the lymphatics of the lateral portion. The submaxillary salivary gland is closely connected and often metastasizes. There is an anastomosis between the lymphatics which drain both sides of the lower lip as well as those draining the central portion. This must be remembered when radiating the lymphatics of the neck. The deep cervical chain extends from the mastoid process to the clavicle: some of the glands lie behind the internal jugular and subclavian veins and cannot be reached surgically without the removal of the jugular. The cervical glands metastasize from the submental and submaxillary. When the submental and submaxillary are palpable, some cancer cells usually have reached the deep cervical chain. If a radiotherapeutist is going to treat epithelioma, he must realize the early invasion of the lymphatic chain the same as the surgeon and treat them by radiation as carefully as a radical operation is performed. The writer has seen cases of epithelioma of the lower lip in which only the lesion of the lip received treatment and in which at the same time the lymphatic glands were involved.

The objection to surgical removal is the frequent recurrence in the scar, because the operation on the glands cannot be sufficiently complete, no matter how thoroughly the dissection is carried out. The removal of the submental part of the parotid, the submaxillary and all the glands which metastasize, together with the ligation and excision of the jugular, is no easy task, besides often leaving cancer cells in deeper glands which cannot be reached.

The advantage of radiation is the removal, in most cases, of the diseased cells without producing deformity and contraction, and healing with very little scar formation. Guided by this consideration, the writer believes radiotherapy, by means of radium and the modern roentgen tube,

at present constitutes the best routine treatment of epithelioma, both at the early and late stage, and that this is one place where surgery, and electric coagulation in most instances, should be employed as an adjunct.

I have seen glandular involvement take place quickly following both surgical removal or electric coagulation primarily in sufficient number of cases to justify a preliminary radium treatment to the lip, a large dose of radium over the submental and submaxillary glands, with a thorough course of roentgen treatment over the entire cervical glands of both sides of the neck. Ten or fifteen years ago I nearly always had the local lesion removed surgically, but in the last four or five years I have recommended radiation as described primarily. The end results by so doing have been at least fifty per cent better. By this I do not mean to delay fulguration or surgery indefinitely. I have seen some cases after radiation given in fractional doses when the radiation was persisted in too long.

What has been said about epithelioma of the lower lip will apply to malignancy of the mouth and throat, because it is only a local disease at the beginning and cannot be determined clinically with any degree of certainty. Epithelioma of the mouth and throat are more difficult to treat and the end results are not equal to those of epithelioma of the lower lip. Many of the early lesions are amenable to radium alone, but the adjacent glands should always receive roentgen treatment. Unfortunately a large majority of the cases are not seen until far advanced. A preliminary application of radium in every advanced case is always advisable, but should not be persisted in too long if the disease does not respond promptly. Electric coagulation is often a valuable adjunct with which to follow radium, as it destroys tissue without opening the blood and lymph vessels and prevents dissemination which might occur with a cutting operation. The large amount of carcinomatous tissue which can be destroyed by electric coagulation, without hemorrhage, is an item of great importance, and compels serious consideration by those who have treated many malignant cases. In some cases, after radium has been pushed almost to the caustic stage, it may be advisable to remove the growth surgically. The combination of surgery, radium, roentgen rays, and coagulation will cure more cases of malignancy of the mouth and throat than any one method alone.

Before any one attempts to treat carcinoma of the breast as an anti-operative measure, postoperatively or for palliation, he should make a study of the lymphatic supply and the extensive metastases which are frequently present, even in apparently early cases. Applying a few radium tubes to the breast, axillary and supraclavicular glands or only radiating these areas by the roentgen rays as many are doing, is not treating carcinoma of the breast intelligently. Such radiation does not treat metastases in other parts and might be compared to surgery done twenty-five or thirty years ago. No matter whether radium or the roentgen rays are employed, clinical experience has proved again and again that permanent results mean more than superficially raying the anterior chest wall, axilla, and supraclavicular glands, because metastases are more extensive than this in at least twenty per cent of the early cases, when the diagnosis can only be made by a microscope, and in over eighty per cent when the axillary glands are palpable at the time of operation. We are looking for the best method of raying the widest area, the deepest with the least effect on the skin and the least loss of radiant energy. The writer has adopted the following method and the experience gained from treatment of recurrence has made him increase the areas from time to time.

1. In order to prevent recurrence in the wound and to destroy any foci in lymphatics of the anterior chest wall leading up to the inner clavicular area, the anterior chest wall from the clavicle to an area below the liver should be rayed.

2. The axilla is cross-fired as much as possible and the area below the liver is included. The supraclavicular glands are usually involved from the axillary.

3. The supraclavicular region is divided into four areas: the rays are directed obliquely inwards toward the cervical glands; on another skin area the rays are directed downward through the shoulder toward the axilla; on another obliquely downwards and backwards through the clavicle, and on another obliquely forward from the posterior surface.

4. The suprascapular area more frequently metastasizes. Each should receive a full dose on the affected side, while on the opposite side the subscapular area might be omitted in early cases.

5. The mediastinum should receive treatment both anteriorly and posteriorly through the chest, cross-firing as much as possible. The opposite breast and its main chain of lymphatics should always be rayed.

6. The epigastric region should never be omitted, as this is one of the avenues by which the liver and pelvic viscera metastasize.

In giving the treatment regardless of what form of radiation is employed, sufficient cross-firing must be used so that the glands deeply situated must receive sufficient amount of radiation, otherwise the treatment is incomplete. Experiments have shown that if the glands are to be treated four inches below the surface, since the intensity diminishes from one hundred to fifteen, the actual intensity at the glands is about one-seventh of that at the surface.

It is a demonstrated fact that in lymphatics, where the vessels are of small size, carcinomatous cells do not disseminate nearly so rapidly as where they are of larger size. It has been proved that the lymphatics undergo sclerosis, thus reducing the size of both the lymph nodes and vessels, which in turn reduces the danger of metastases. A cancerous mass, after being rayed, changes in type, becoming more scirrhous, and is rendered much less malignant.

In every case of carcinoma of the uterus, regardless of the stage and whether it is used as a prophylactic measure after operation or in recurrent or inoperable cases, radium should always be used locally, and all the visceral and inguinal glands should be treated by the roentgen rays, cross-firing as thoroughly as is advised for uterine fibroids A study of carcinoma of the uterus from incipiency to the time the liver and other visceral organs become involved in fatal cases, and a careful following up of cases, have shown conclusively that in all cases the combination of radium and the roentgen rays produce the best results in conjunction with the proper surgical treatment. It is only necessary for any one to follow up a number of cases to be convinced that locally radium is by far the best form of radiation in cancer of the uterus. The mucous membrane of the vagina will tolerate from five to eight times more radiation than the skin over the abdomen, and this alone should induce any clear thinker not to attempt to destroy local carcinoma by roentgenotherapy through the abdomen, as many roentgenologists are doing, when radium is available. A study of carcinoma of the uterus in gynecological clinics, and the Wertheim operation, or a modification of it, will soon convince the radiotherapeutist that treating carcinoma of the cervix and uterus by radium locally will go a stage beyond surgery and cure cases in which no abdominal metastases have taken place. It is a much easier task to treat carcinoma of the uterus locally by radium than to treat the adjacent glands which metastasize. Both are mathematical problems, but the latter is more complex than knowing the roentgen ray equation employed in deep therapy. I do not mean to say that the same accuracy in technic must not be employed, because cross-firing, filtration and the dosage for each case must always be determined when employing radium, depending upon the size of the growth and the space around it.

The results obtained from the surgical treatment of carcinoma of the uterus either emphasize the importance of seeing the cases earlier and of doing more radical operations than have been heretofore performed, or else it suggests the addition of radium or the roentgen rays before we are able to cure a majority of the cases which can be diagnosed clinically.

In conc us on, the combined or selected methods of rad um, roentgen rays, and surgery when remova is necessary, to-day provide the on y rational and efficient means of treating malignancy. The consu tant must be thoroughly conversant with principles that have been established, experienced and without prejudice. Sufficient data have been produced n the past fifteen years to give radiotherapy a sound and rational place n the treatment of malignancy. This has been accomplished by the team work of the clinician, pathologist, surgeon and radiotherapeutist. The data are so conc usive that there cannot possibly be an excuse, except through ignorance (and ignorance is no excuse), for experimenting or selecting the wrong method of treatment.

RADIUM COMBINED WITH ELECTROCOAGULATION, SURGERY AND DEEP ROENTGENOTHERAPY IN THE TREATMENT OF MALIGNANT DISEASE*

BY G. E. PFAHLER, M.D.

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RADIUM has been proven of definite value in the treatment of malignant disease. Success has followed its application at the hands of many physicians. The most striking successes have been in the visible and palpable superficial lesions, which are the same kind of cases in which all the other methods of treatment have been the most successful. So, too, surgery, electrocoagulation and roentgenotherapy have proven themselves of distinct and positive value in the cure of malignant disease; but none of these methods are entirely satisfactory. No single method known to science to-day will cure all cases of malignant disease. It is our duty to utilize any of the methods which have been proven satisfactory in each individual case according to the indications and according to the likelihood of success. There are certain types of cases which cannot be expected to get well with any single method of treatment, but which have a reasonable chance of recovery if one or more methods are combined, and I believe that, since no single method of treatment can be depended upon to produce uniform success in all cases, it is our duty to utilize each and every method in combination that will increase the percentage of cures.

For many years most surgeons and all roentgenologists have been recommending postoperative *x*-ray treatment, or, in other words, a combination of surgery and deep roentgenotherapy in the treatment of malignant disease. This postoperative treatment by deep roentgenotherapy is, therefore, a combination of surgery and roentgenotherapy. During the past two years I have been recommending antioperative treatment, with the object of reducing the malignancy of the cells, and thereby preventing or retarding recurrence. By that I mean that deep roentgenotherapy should precede the operation, and as soon as the course of treatment is given, which should not require more than a few days, the patient should be operated upon without waiting for results from the roent-

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genotherapy. This should then be followed by postoperative treatment at an interval of four weeks.

During the past six years I have been combining in a number of cases electrocoagulation, radium, surgery and deep roentgenotherapy, with results which I believe could not have been produced by any single method. The cases which I desire to report under this title serve merely as illustrations of what can be accomplished and how these various methods can be combined to advantage. I am sure that whenever two or more methods can be used in the treatment of a case of malignant disease the chance of permanent recovery will be increased. In other words, by skillful combination of these methods named our total percentage of cures of malignant disease can be increased.

The general uses of radium are being discussed by very competent men, and many cases of malignant disease have been reported cured by radium alone. I shall, therefore, refer to no cases in which I have not combined the use of radium with other methods.

It is with the hope of preventing reinoculation, or extension of the disease, that I have been recommending during the past six years the use of electrocoagulation; and it has been with the hope of reaching the metastases and of destroying any remaining cells that were not removed by the operation, that has led most of us to recommend deep roentgenotherapy as a postoperative measure. Roentgenotherapy cannot be applied, however, to malignant disease located within the cavities. It is in this group of cases that I believe radium fills a peculiar need, and I believe that if radium is applied to malignant disease within cavities, giving it every possible advantage, and if one combines with this, the other well-known methods of curing malignant disease, a greater percentage of these troublesome cases can be cured than has ever been recorded to date. When radium is applied within the cavities it is well known that the chief effect extends approximately only two centimeters in depth. Therefore the radium cannot be expected to reach the outlying cells or the metastases. For this reason deep roentgenotherapy applied externally and added to the effect of the radium internally gives a great advantage. In all cases of carcinoma within cavities, radium and deep roentgenotherapy can be combined. In some cases, all four methods mentioned in the title of this paper can be used to advantage. For the purpose of illustrating the methods of combining these various agents, I desire to report a few illustrative cases.

CARCINOMA OF THE MOUTH

CASE I.—Mr. J. L. P., age fifty-eight, was referred to me by H. W. Dachtler and H. E. Deemer on January 20, 1913. During ten years he had an epithelioma on the inside of the left cheek, and at the angle of the mouth. He had received some *x*-ray treatment during a number of years, and finally was referred to Dr. Dachtler for *x*-ray treatment. Under Dachtler's care the patient almost recovered, but during his absence the disease developed rapidly and at the time he was referred to me the disease involved two-thirds of the upper lip, half of the lower lip, with a vegetative projecting epithelioma at the angle of the mouth approximately 1 inch in diameter. The disease extended backward on the inside of the cheek to the angle of the jaw. The entire diseased area was destroyed by electrocoagulation and carved out. Deep roentgenotherapy was then applied to the entire left side of the face and the glandular area underneath the jaw. Radium was applied on the inside of the mouth at the angle of the jaw. Under this treatment, all evidence of malignant disease disappeared. At the end of a year, when he seemed to be perfectly well, Dr. Laplace, at my request, did a plastic operation, closed his mouth, and since this time he has remained entirely well. In other words, he has remained well approximately five years, having received all four

kinds of treatment. In this case we combined four methods of treatment—electrocoagulation, deep roentgenotherapy, radium, and finally surgery. I believe that no single method, and probably no two methods, could have produced these results.

CASE 2.—Mr. W. E. R., age forty. On June 10, 1915, the patient was brought to me by Dr. Ernest Laplace as an absolutely hopeless case of malignant disease of the mouth. When he came to us at this time he had carcinoma involving the entire left cheek, the alveolar process and gum on the left side of the superior maxilla, and the entire left lower maxilla, extending through to the angle of the left jaw. The disease extended backwards and involved the anterior pillar of the fauces, and there was a mass of metastatic disease the size of a hen's egg under the left maxilla. In a combined operation at this time we destroyed the malignant disease in the mouth by electrocoagulation, the metastatic glands were dissected out, and the left half of the lower jaw was removed. The entire area was treated by deep roentgenotherapy immediately after the operation, and then at intervals of a month a series of doses were given through twelve different areas. Radium was applied in the region of the left superior maxilla, which seemed to be the area in which the disease was most likely to extend, and most difficult to reach by roentgenotherapy. At the end of six months, the wound had assumed a healthy appearance, and seemed free from malignant disease. An effort was then made to close the mouth by suturing. The first attempt failed. A second attempt failed. After the second attempt the patient had a secondary hemorrhage which was ably controlled by Drs. Gass and Shindle at the patient's home in Sunbury. Finally, on June 9, 1916, exactly one year after beginning treatment, the mouth was successfully closed. It has continued closed and has remained healthy since this time, or exactly four years from the day that he was brought for treatment.

In each of the cases reported above, all four methods of treatment described in this paper were utilized, and each to advantage, and I doubt very much whether the patient could have recovered without the use of the four methods. One cannot, however, always utilize all of them. The following two cases will illustrate the success that may be obtained from the use of two methods, which I believe can always be applied.

Sarcoma within the mouth is difficult to reach satisfactorily by deep roentgenotherapy, and it is not suitable for electrocoagulation. In this group especially radium is indicated, but even in this group of cases, radium can be combined to great advantage with deep roentgenotherapy, as will be illustrated in the three cases which follow:

CASE 1.—Mr. G. E. T., age seventy-one, was referred to me on May 11, 1914, by Dr. H. H. Grace. Six years before he had developed a tumor in the hard palate recognized originally by a dentist, supposed to be due to an ill-fitting plate. Finally the disease had developed to such an extent that it interfered with his breathing. It was generally impossible for him to breathe through his nose. When he came to me for treatment, the tumor involved the entire hard and soft palate, with a growth projecting upwards into the antrum and in the posterior nares, so as to obstruct breathing entirely on the right side, and almost completely obstructing breathing on the left side. There was an ulcerated area on the roof of the mouth approximately the size of a silver dollar. The disease was treated within the mouth by means of the x-rays directed through a tube and applied from four different angles. Cross-firing was done from twelve different angles on the outside of the cheek, and radium was applied through the nostrils, and in the region of the posterior nares so far as was possible. He was gone over in this way five times between May 11, 1914, and April 12, 1915, at which time the diseased area was reduced to about one-

sixth of its original size, his general health was good, the ulcer in the roof of the mouth had healed, his breathing was free, and he believed himself to be well. Against my advice he discontinued treatment. He remained free from symptoms, however, until March 26, 1919, when he began to notice the reappearance of the lesion. We have repeated this course of treatment, and there has been marked improvement. I believe that if he persists in the treatment he should recover.

CASE 2.—Mr. J. P. L., age fifty-two, was referred to me by Dr. Geo. C. Stout on April 24, 1917. His condition was very similar to the previous case, excepting that the ulcer had perforated the palate. A Wassermann test was negative. He has been gone over eleven times between April 24, 1917, and January 6, 1919, the line of treatment corresponding to that described in the previous case. At the time of his last treatment, Dr. Stout believed that he was well, and considered seriously the question of doing an operation to close the perforation in the palate. I fear operating in these regions because of the likelihood of the malignant cells being only encapsulated and the operation releasing them, after which the disease is likely to progress. I therefore advised waiting and advised that the perforation in the palate be dealt with by means of a dental plate which would answer every purpose, and I believe could do no harm. If he remains well for a year I believe that an operation to close the palate should be seriously considered.

CASE 3.—Miss M. P., age eighteen, was referred to me by Dr. Wm. Menah, April 19, 1918, with a recurrent sarcoma filling the right posterior nasal space. At the time that she was sent to me there was a triangular tumor about 1½ inches on each side occupying the posterior nasal space, slightly more on the left than on the right. She was given six courses of treatment within six months. Each course involved eight doses of *x*-rays given through eight different portals of entry, one dose being given inside the mouth directed toward the palate. In addition to this 50 milligrams of radium were introduced into the posterior nares as far as the tube could be inserted through the nostril, and allowed to remain there one and one-half hours, and were filtered through ½ millimeter of silver, and a millimeter of rubber. The tumor had completely disappeared at the end of six months, and she has remained well to date, which is fourteen months since beginning treatment, and eight months since the treatment was discontinued.

I believe that surgical excision or destruction by electrocoagulation should not be used on sarcoma unless one can be sure of surrounding and removing all of the disease.

CARCINOMA OF THE ESOPHAGUS

This region I believe also offers a field for combined treatment by means of radium and deep roentgenotherapy. In this group I have no cures and no approximate cures. I have treated several cases, but all were very far advanced; and while I seem to have obtained in all temporary improvement, the ultimate results were bad—that is, failure in getting the patient well. It seems to me, however, that radium should be useful if the capsule is passed directly into the stricture, and allowed to remain there a sufficient time to cause a destruction of the growth; and especially is this true when it is passed under the guidance of the fluoroscope and definitely located within the growth and changed according to the needs. If to this one adds thorough cross-firing through all the angles of the chest, I believe good results should be obtained, though I have none to report.

CARCINOMA OF THE UTERUS

Brilliant results have been reported by Koenig and Gauss, Kelley and Burnham, John G. Clark, Boggs, Frank, and others, in the treatment of carcinoma of the uterus. Therefore radium has proven itself of value in this disease; but with all the successes

that have been obtained there have been many failures, and theoretically at least it would seem, if one associated deep roentgenotherapy applied through various angles or fields of entry surrounding the abdomen, cross-firing upon the disease from every angle possible, that in this way with the immediate or local effect of the radium one should be able to destroy or devitalize the carcinomatous tissue which had extended beyond the reach of the radium when placed within the vagina or the uterus. In this group I have treated, and am treating, a number of cases. I will only refer to one in which the results seem to be especially brilliant.

Mrs. F. J. J., age forty-one, was referred to me by Dr. Barton Cook Hirst October 8, 1918, who found an extensive carcinoma of the uterus, entirely inoperable, involving the cervix and the entire upper portion of the vagina. There was an ulcer 1½ inches in diameter with a crater about ¾ inch deep; the whole area was indurated, and there was extensive infiltration in the pelvis in all directions. Fifty milligrams of radium element, surrounded by ½ millimeter of silver, 1 millimeter of bronze, 3 millimeters of rubber, were imbedded in the ulcerating mass for four days. This was followed by a series of thirty doses of *x*-rays applied through thirty portals of entry in all directions through the abdomen. There were no unfavorable symptoms. At the time of beginning treatment, it required ¼ gr. of morphine daily, the patient suffered excruciating pain, and had continual bleeding. She returned on November 1, 1918, approximately five weeks from the time of beginning treatment. She looked very much better, and was practically free from pain, ate very well, was much stronger. Inspection of the vagina showed a small ulcer or fissure about ¼-inch in diameter, from which there was a slight blood discharge. Almost no crater was left, the general tissues of the pelvis were soft, the cervix was freely movable and all the previously described malignant tissue was replaced by scar tissue. It seems hardly believable that so much improvement could have occurred in so short a time. The patient was then given a second course of deep roentgenotherapy, the radium was reapplied for twenty-four hours, and there was good reason to expect a recovery in this patient based upon the results obtained. The patient went home, and a few weeks later developed influenza and died of pneumonia.

CARCINOMA OF THE BLADDER

Carcinoma of the bladder has not been treated with brilliant results by any single method. I have treated several cases by introducing radium into the bladder through a rubber catheter, and applied *x*-rays externally, cross-firing through the abdominal wall, but in none of these have I obtained any more striking results than temporary improvement. In two there was a combination of surgery, electrocoagulation, radium and roentgenotherapy; and I believe the patients will get permanently well. One was treated two years ago, and the second about three months ago. The second case was treated by Dr. Laplace and myself, according to my ideal of methods.

CASE 1.—Mr. X., age thirty-seven, was referred to me July 3, 1917, by Dr. T. E. Wills. The patient had suffered from hematuria for over a year but had not had a a cystoscopic examination until a month before he was referred to me. Two weeks before he returned to me the patient had been operated upon by Dr. Nassau for carcinoma of the bladder. The tumor was the size of a small orange. The entire base of the bladder was infiltrated, and at the time that he was referred to me this area was still indurated. Six doses of *x*-rays were applied through the opening into the bladder, twelve doses applied anteriorly through the abdomen, and two posteriorly. Then radium was introduced into the bladder, 25 milligrams, for forty-eight hours. At the end of four weeks examination of the bladder showed a recurrence of disease

with bleeding papillomata, which seemed to be malignant. The patient was then anesthetized, and all these bleeding areas and all areas of induration were destroyed by electrocoagulation. Radium was introduced into the bladder, 25 milligrams, for forty hours. Deep roentgenotherapy was then used through nineteen different areas cross-firing upon this diseased area. During the next month, or third series of treatment, the patient received sixteen doses of *x*-rays, and the 25 milligram specimen of radium was applied in the bladder for eighteen hours. The patient received four series of treatment in all, and on September 14, 1918, Dr. McKinney made a cystoscopic examination, found the bladder free from tumor, and advised closing the cystotomy wound. This operation was done, and the patient has remained well to date, or approximately two years from the time of his original operation. He therefore has a reasonable hope of remaining permanently well.

CASE 2.—Mr. E. S. J., age fifty-two, was referred to me April 7, 1919, by Dr. Ernest Laplace for an examination of his bladder on account of hematuria. I injected the bladder with air and found a papillomatous tumor on the left side of the bladder, about 2 inches in diameter, irregular in outline, and apparently having a broad base. These conditions led me to believe that it was carcinomatous. After consultation with Dr. Laplace, we agreed upon a combined treatment. We did a cystotomy, and through the cystotomy wound I destroyed the entire tumor by electrocoagulation, guiding and judging the destruction by my finger in the rectum. This served as a guide against destroying the bladder wall and against making a fistulous opening into the rectum. I placed 100 milligrams of radium in a half millimeter of silver, a millimeter of bronze, and 3 millimeters of rubber. This was placed directly over the area which had been diseased. The bladder was then packed with sterile gauze, and this radium was allowed to remain for twenty hours, making twenty milligram hours of radium treatment in which we made use almost exclusively of gamma rays. We next gave the patient a course of twenty doses of deep roentgenotherapy, applying it through twenty different areas, cross-firing upon the bladder area and the lymphatic glands leading therefrom. As a result of this treatment, which I consider ideal, there have been no unfavorable symptoms. There was no reaction after the operation. In about ten days the urine flowed clear, and for the most part drained through the urethra. The time, of course, is too short to judge the result of this case, and it is not intended as a report of results, but of what I consider the ideal method of treatment in tumors of the bladder.

CARCINOMA OF THE RECTUM

Treatment of carcinoma of the rectum is probably the most unsatisfactory and the least successful of all carcinomata in any part of the body. It is unsatisfactory, first, because the cases usually come late, after the disease has extended a considerable extent into the bowel, and second, because metastasis takes place rather early. I have attempted the treatment of several cases by introducing a capsule of radium within the constriction caused by the carcinoma, and cross-firing externally by deep roentgenotherapy; but in no case have I obtained cures. In several cases I have obtained amelioration, and for a time I believed the patient was going to get well, but ultimately I was disappointed.

PITUITARY TUMOR

The symptoms of pituitary tumors develop very slowly, and their effects are often of a permanent character, so that one cannot judge very accurately as to the results obtained from any particular kind of treatment, excepting in so far as the symptoms do not progress. I can refer to but one case, which is reported more by way of illustration as to how radium and

deep roentgenotherapy can be combined in the treatment of this disease.

Mrs. W. S. J., age thirty-two, was referred to me for x-ray treatment of the pituitary region November 28, 1917, by Dr. Chas. Frazier and Dr. Thomas Holloway. The patient had had pituitary disease for some time, with the chief symptom of headache and loss of vision. She was operated upon April 1, 1916, by Dr. Cushing. At the time that she was referred to me she was suffering from a recurrence of all the symptoms, which had increased rapidly. Dr. Cushing had previously done a transsphenoidal operation. The eyes returned to normal within two weeks after Dr. Cushing's operation, and the headaches were relieved somewhat, but not entirely. During the past five months the patient had had recurrence of the eye symptoms—at least the eyes were worse than at the time of the previous operation. In addition to this she had the characteristic symptoms of acromegalia. She had taken extract of pituitary and thyroid extract and suprarenalin during July, August and part of September, but with no good results. She felt that her eyes had become rapidly worse since stopping the treatment. X-ray examination showed a great enlargement of the sella turcica, the size being at least an inch in the anteroposterior direction. The height of the posterior clinoid process was approximately one inch, the posterior clinoid process being pushed backwards. Eight doses of x-rays were given, cross-firing upon this disease November 28 and December 1, 1917; and she was given 300 milligram hours of radium on December 4, 1917. She was given an additional eight doses of x-rays on December 18th. This course of treatment was repeated in January, 1918. A third course of treatment, of a similar nature, was given during April. On May 22, 1918, Dr. Holloway reported that her condition had remained stationary during the past three months; her headache had improved. October 3, 1918, Dr. Holloway wrote that the patient's eyes continued to do well, and that when examined the week previously she had normal vision in both eyes. The fields of vision showed no further change excepting that the slight scotoma that was present in each eye had entirely disappeared, so he reported her condition improved.

This brief review of cases does not permit us to draw any definite conclusion at the present time, and is made more with the idea of showing how different methods of treatment can be combined to cure a group of cases that are generally considered hopeless.

DISCUSSION

Dr. William L. Clark, Philadelphia.—The value of the methods related by Dr. Pfahler is so common-sense and so proven by experts that the discussion of the subject in general is hardly necessary. We are in complete accord on this subject, with the exception of a few minor details. All I shall attempt is an amplification of the things that he has brought out. In order that I may utilize to the best advantage the time at my disposal I will ask that a few pictures of my own may be thrown upon the screen. I have worked more with the electrothermic methods than with the others, but I am treating more cases with radium every day.

Dr. Isaac Levin, New York.—I believe we all realize that Dr. Pfahler is a pioneer in this work. For more than a decade he has been fighting single-handed for what the whole Society now intends to do—destroy prejudice and inspire confidence among surgeons in this ray-therapy. I believe that owing to Pfahler's work there is more confidence in this method among the surgeons in Philadelphia than in any other town in the country.

I believe with him that we ought to combine all of the four methods, and more. I also believe that electric surgery, as well as the knife, is only adjuvant to the ray-therapy. Only by subsequent persistent employment of the latter method can the best results be obtained. No matter how completely we destroy the growth by surgical measures there are always a few cancer cells left behind. I have gathered evidence to show that there is never a perman-

ent cure in cancer. We only prolong life. Twenty and even thirty years later there may be a recurrence of the same type of cancer after a radical operative removal of the primary growth. The arrest of the development of the remnants of the cancer for a number of years by the aid of postoperative radiotherapy presents a sufficient therapeutic accomplishment.

As regards the difference between x-ray and radium therapy, I do not believe that it is only a question of convenience. There is a certain qualitative difference between these two agents. Radium burns and x-ray burns are clinically undoubtedly different conditions. Moreover, even from the standpoint of convenience it is not only tumors in the cavities which are more favorably influenced by radium. Small tumor masses, as for instance small local recurrences of carcinoma or involvements of lymph glands, are far more readily influenced by radium than by x-rays. I have had many such cases in which x-rays failed but radium succeeded. But generally in cases of malignancy we ought to employ all the methods in our therapeutic armamentarium, and then only will the greatest success be obtained.

Dr. Henry Schmitz, Chicago.—One important point brought out by Dr. Pfahler which I think of great value, is the interim to be observed between radium treatment and operation. He mentioned that the interval should be very short, possibly the next day or two days. It is almost five years since we have instituted the combined method of operation and x-ray and radium therapy. We have had many cases, and our experience differs somewhat from Dr. Pfahler's. If we operate a patient and treat him with radium rays immediately or shortly before the operation, we have observed a great many septic infections, due to lowered resistance, local as well as systemic. On the other hand, if we wait for two or three weeks, wait until the septic complications subside, but before the connective tissue stage due to the reaction from the radium is completed, we see our patients through the operation without fear of sepsis. We never should wait until the radium and roentgen ray reaction is completed because it is difficult to operate on a patient with heavy scar tissue in the pelvis. Should hemorrhage be profuse we arrest it by the application of heat, or put on clamps which are left for thirty-six hours, when they are carefully removed. Dr. Pfahler's paper is excellent, and we all realize that whenever we hear anything from him we hear the law of the application of rays. His work has been eminent and has stimulated the rest of us to better effort.

Dr. George E. Pfahler.—There is little to close in the discussion. I would like to emphasize another point in connection with the subject brought up by the President with regard to ante-operative treatment. I think his observations in regard to all postoperative treatment of carcinoma in the bowels is probably correct, but in a number of cases of carcinoma of the breast we applied the rays immediately after the operation in the open wound and had no bad results. This would not hold so well in treatment of pelvic conditions because there we are more apt to get constitutional symptoms and it is probably a fact that it is best to wait awhile. That is the postoperative treatment.

In respect to the ante-operative treatment I have had no objections from any of the surgeons regarding it. In carcinoma of the breast not only do I think that we ought to do ante-operative treatment, but I think every case should be examined by the x-rays preceding operation to determine metastases in the lungs and chest. Last Friday I had two cases of carcinoma of the breast sent to me and I found not only metastases in the lungs and mediastinum, but in the vertebræ, preceding the operation. You can understand that anteoperative treatment or any other form of treatment would not be a success in such a case. If we combine the radiotherapy with operation the patient's life may be prolonged but he will not get well. I have had patients live for two or three years, but never with metastases of the bone have they gotten well.

RARER TYPES OF FRACTURES

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IT is a fact well known to surgeons and to roentgenologists that practically all fractures can be grouped into types. With the commoner types most physicians and surgeons are familiar. Among these may be mentioned Colles' fracture, Pott's, fractures of the shaft of the bone, fracture of the surgical neck of the humerus, fracture of the olecranon, "T" fractures at the elbow and knee, fracture of the neck of the femur. The pathology, clinical signs and symptoms, together with the methods of treatment of these fractures, have been taught in our medical schools for more than a century.

The history of the development of our knowledge of the common types of fractures is interesting. It shows that our knowledge was first obtained from clinical observation and anatomical dissections (museum specimens). Later, with the beginning of the era of asepsis, it was greatly increased by open operation. Finally the *x*-ray was discovered to aid us in our knowledge and to show the error of many of our previous conceptions of fractures. It is not too much to say that the knowledge gained by the use of the *x*-ray has revolutionized our conception of fractures and that it has been necessary to rewrite our text-books. Accurate knowledge of detail of fractures has taken the place of the opinion of the authorities of the text-books. Many of the older teachings have been shown to be erroneous. It is now known, for example, that fractures of the carpal and tarsal bones are not uncommon. Many so-called sprains are shown to be fractures, e.g., impacted fracture of the neck of the femur, fracture of the head of the radius, fracture of the greater tuberosity of the humerus, linear fracture of the bones near large joints—as chauffeur's fracture, fracture of the external malleolus of the ankle, linear supracondyloid fracture of the humerus, etc. Some of the old classical fractures have either been set aside completely or found to be very uncommon and many new types have been added. Fracture of the anatomical neck of the humerus is known to be a rare condition. Fracture of the greater tuberosity is exceedingly common. The old "T" fractures of the elbow and knee, while they do occur, are not so common as fractures above the condyles or through one or both.

An example of the increased detailed knowledge obtained by the *x*-ray in our known types of fractures might be illustrated by the history of Colles' fracture. The most common type of fracture of the lower end of the radius was first described by the Irish surgeon, Colles, in 1814. Colles described his fracture as a fracture of the lower end of the radius, one and a half inches above the articulation. He first described the condition in order to differentiate from dislocation of the wrist. Twenty years later, impacted Colles' fracture was described. *X*-ray examination of a great many of these so-called Colles' fractures have shown that there are a great number of fractures of the lower end of the radius quite different from the fracture first described by Colles. We know that fracture of the lower end of the radius is often associated with that of the styloid of the ulna, that comminution frequently occurs, that the line of fracture varies in its relation to the articular surface, that the displacement, while usually backward, may be forward (reversed Colles').

The skilled surgeon in most cases is able to recognize the common types of fractures by classical signs without the *x*-ray. He uses the *x*-ray for detailed information as to the line of fracture, presence or absence of comminution, direction of deformity, etc.—information valuable in aiding reduction. After reduction he uses

the x-ray as a check upon his work and to ascertain whether or not the reduction has been maintained. The surgeon who interprets his own x-ray plates can often picture in his mind from his clinical examination just what the x-ray will show; in other words he can visualize an x-ray plate for the particular fracture under consideration. This is especially true of the commoner types of fractures, Colles', Pott's, etc. The same, however, cannot be said of the rarer types, as few individual surgeons, except those who see a great number of fractures, have the opportunity to see these types of fractures often enough to recognize them at once and to be able to visualize them on the x-ray plate. The object of this paper is to call the attention of the roentgenologists to certain fractures with which they are familiar and to emphasize the importance of recognizing these fractures as types.

They are types of fractures in the same sense that Colles' and Pott's are types. They have a definite etiology, characteristic signs and symptoms, and can be as definitely diagnosed and visualized on the x-ray plate as the more common types. The active roentgenologist who makes x-ray examinations of fracture cases for many surgeons has an excellent opportunity for studying these types and for educating the profession to recognize them. If roentgenologists would devote more time to the study of fracture cases from the point of view of diagnosing types of fractures, their work would be of far greater value to the surgeons who refer their work to them, to the patient and to the general profession. The x-ray diagnosis of types of fractures is the most important part of the roentgenological examination and should precede any minute description of line of fracture or displacement. If roentgenologists would begin in their reports by saying, for example, "this is a base of the fifth metatarsal" or "a tip of the external malleolus" or "a linear supracondyloid humerus fracture" and then proceed to give in detail directions of the line of fracture, deformity, etc., these fractures would soon become recognized as types just as Colles' and Pott's fractures are now recognized. These rarer fractures should be considered types for the reason that, with a definite etiology, these same fractures occur repeatedly, and they have characteristic signs and symptoms which enable the surgeon who is familiar with types to make the diagnosis without the x-ray. Most skilled surgeons are able to diagnose these rarer fractures either with or without the x-ray, but how many of the general profession recognize them as distinct types?

I feel sure that the observing roentgenologist has the opportunity, if he will avail himself of it, to educate the profession in general to recognize these rarer fractures as definite types. It is not possible in a limited article to describe all of the rarer types of fractures. It will only be possible to give illustrations of some of the most characteristic. Some of the fracture types described and illustrated below occur very frequently and are well known to the experienced surgeon; others, while not common, cannot be classed as rare; others are, relatively speaking, rare types. Most roentgenologists will recognize old friends in these illustrations. Probably none of the illustrations shown are new to the active roentgenologist. If, however, I succeed in emphasizing the fact that these fractures are types, the object of the paper will be achieved.

No. 1.—Knuckle Fracture (fracture of a metacarpal bone just behind the head). This type is very common.

Etiology.—Blow on knuckle.

Signs and Symptoms.—Knuckle drop; head of metacarpal in palm; lower end of distal fragment on dorsal surface; local tenderness; shortening; mobility and crepitus. The x-ray is invaluable in differentiating this fracture from dislocation of the metacarpo-phalangeal joint and from old fracture deformity. (Fig. 1.)

No. 2.—Fracture of the Base of the First Metacarpal (Bennett's or stave fracture).

Etiology.—Direct violence, blow against base of thumb, causing backward and upward displacement.

Signs and Symptoms.—Swelling; local tenderness; loss of function; may be crepitus and abnormal mobility. It is to be

FIG. 1. KNUCKLE FRACTURE (FRACTURE OF A METACARPAL BONE JUST BEHIND THE HEAD).

differentiated from dislocation of the carpometacarpal joint for which it is frequently mistaken by the inexperienced. Dislocation is very rare. This type of fracture occurs rather frequently. The x-ray is very useful

FIG. 3. FRACTURE OF THE SCAPHOID AND DISLOCATION OF THE SEMI-LUNAR (SEE THIS PARTICULAR CASE—FRACTURE OF THE STYLOID OF THE RADIUS ALSO).

in differentiation and in determining the amount of displacement or degree of impaction. (Fig. 2.)

No. 3.—Carpal Fractures. The x-ray has shown that fractures and dislocations of the carpal bones do occur and that fracture of the scaphoid especially (with or without dislocation) is not an uncommon injury.

FIG. 2. FRACTURE OF THE BASE OF THE FIRST METACARPAL.

Etiology.—Fracture of one or more carpal bones may be due to severe direct violence and associated with fracture of the radius and ulna. Fracture of the scaphoid is caused by a fall on the pronated hand. There are several varieties, namely: (a) fracture without displacement; (b) fracture (two or more fragments) with displacement; (c) fracture with displacement

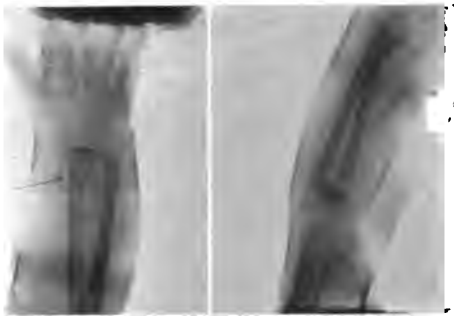

FIG. 4. GERUSTICH OR SUBPERIOSTEAL FRACTURE OF THE LOWER THIRD OF THE RADIUS.

of fragment and associated dislocation of the semilunar. The latter combination (fracture of the scaphoid with dislocation

of the semilunar) is seen often enough to be classed as a definite type, being second in order of frequency of the carpal injuries. Incomplete fracture of the scaphoid is the most common variety.

Signs and Symptoms.—Swelling over the palmar and dorsal surfaces of the scaphoid and in the snuff box; limitation of wrist motions, especially abduction and extension. In old cases with displacement there is well marked thickening. The *x*-ray is indispensable in accurate diagnosis of this fracture. Both the two-way right-angle views and stereoscopic plates should be taken. A good working knowledge of osteology on the part of the roentgenologist or the surgeon who interprets his own plates is necessary to interpret this fracture correctly. Care should be taken not to mistake the normal rarefaction of the neck of the scaphoid for fracture. The writer has seen this mistake made several times. A good negative of both wrists in an anteroposterior position (Codman's method) *may* be sufficient to show a fracture of the scaphoid, but it is entirely inadequate to show possible associated dislocation of the semilunar or os magnum or the amount of displacement of the fragments. In "fracture-of-the-scaphoid-dislocation-of-the-semilunar" type, the semilunar usually goes forward with the radius and one or both scaphoid fragments, while the os magnum is displaced to the dorsal surface. A less common injury is complete forward dislocation of the semilunar from both radius and os magnum, with or without fracture of the scaphoid. (Fig. 3.)

FIG. 5. FRACTURE THROUGH THE ARTICULAR SURFACE OF THE HEAD OF THE RADIUS.

FIG. 6. FRACTURE OF ULNA, UPPER THIRD, AND FORWARD DISLOCATION OF THE RADIUS.

No. 4.—Greenstick or Subperiosteal Fracture of the Lower Third of the Radius. This is a rather common type of fracture in children. The same fracture is seen in the ulna and also in both radius and ulna together. The fracture of the radius, however, is seen more frequently in the *x*-ray laboratory. It may be greenstick with

deformity or sub-periosteal with very little deformity.

Etiology.—Fall on hand.

Signs and Symptoms.—Pain and swelling; local tenderness; more or less deformity; absence of crepitus. The x-ray should be used to differentiate from Colles' or separation of the lower epiphysis of the radius, and to show the exact deformity. (Fig. 4.)

No. 5.—Fracture of the Head of the Radius. Fracture of the head or neck of the radius is one of the fractures which has been rescued from the sprain group by the x-ray and is now known to be a not uncommon injury.

Etiology.—Either direct violence, or fall on the pronated hand with the elbow extended.

Signs and Symptoms.—Limitation of pronation and supination with slight limitation of flexion and extension; swelling over the upper end of the radius. The fracture may be in the neck, below or above the orbicular ligament, or in the head. The variety shown in the illustration is fracture through the articular surface of the head. The signs and symptoms of this variety are limitation of pronation and supination; tenderness over the head without deformity; swelling between the head of the radius and the external condyle due to effusion in the joint. A positive diagnosis can be made only from the x-ray plate. (Fig. 5.)

No. 6.—Fracture of the Ulna, Upper Third, and Forward Dislocation of the Radius. This is a definite type which is not often seen.

Etiology.—Usually direct violence—blow or fall upon back of elbow below joint.

Signs and Symptoms.—The usual signs of fracture of the upper third of the subcutaneous ulna are present with the prominent head of the radius in front of the outer side of the joint. The lateral x-ray plate shows the condition best. Although it is out of order in this communication, the writer cannot resist writing something concerning treatment. Bad end results are seen not infrequently in this type of fracture. The head of radius may be unreduced or the fractured ulna ununited. These old cases require operative treatment, either resection of the radius or wiring of the ulna, sometimes both. Proper treatment of the recent injury will, in the majority of cases, prevent bad results and give good function. They should be treated by first reducing the dislocation of the radius and adjusting the ulna to as good position as

FIG. 7. LINEAR SUPRACONDYLOID FRACTURE OF THE HUMERUS IN CHILDREN.

possible and then placing the elbow in position of acute flexion. This position maintains the head of the radius reduced and through the tension of the deep fascia of the forearm caused by pull of the triceps and leverage upon the lower portion of the ulna, reduces overriding and maintains efficient approximation of the fractured

bones. If this method of treatment is carefully carried out, resection of the radius or wiring of the ulna will seldom be necessary. (Fig. 6.)

No. 7.—Linear Supracondyloid Fracture of the Humerus. Supracondyloid fracture of the humerus is probably the most common type of elbow fracture in children. The complete fracture presents such characteristic signs that the experienced surgeon has very little difficulty in recognizing the fracture without the x-ray. The variety of fracture shown in the illustration—linear supracondyloid fracture of the humerus—is one that can only be diagnosed by a good x-ray plate. The line of fracture is transverse and may be only a crack in the bone. This variety is not very rare.

Etiology.—Blow or fall on the elbow in hyperextension.

Signs and Symptoms.—Swelling in front and behind over the lower end of the humerus; local tenderness in the same location; limitation of complete flexion and extension; pronation and supination normal; neither crepitus nor abnormal mobility present. With these signs one can often visualize a correct x-ray diagnosis before the plate is developed. (Fig. 7.)

FIG. 8. SUBPERIOSTEAL FRACTURE OF THE UPPER END OF THE HUMERUS IN CHILDREN.

FIG. 9. FRACTURE OF THE GREATER TUBEROSITY OF THE HUMERUS.

No. 8.—Subperiosteal Fracture of the Upper End of the Humerus in Children.

Etiology.—Fall on hand with arm abducted so that the strain falls upon the upper end of the humerus rather than upon the lower end or the head of the radius.

Signs and Symptoms.—Pain referred to the deltoid region; inability to abduct the arm; tenderness over the upper end of the shaft of the humerus; disinclination to use the arm; no crepitus or abnormal mobility. These signs in children should always excite suspicion of this type of fracture. A positive diagnosis can only be made from the x-ray plate. (Fig. 8.)

No. 9.—Fracture of the Greater Tuberosity of the Humerus.

Etiology.—Direct violence or muscle pull by the external rotators, which are attached to the greater tuberosity.

Signs and Symptoms.—Loss of external rotation, tenderness over the greater tuber-

osity; sometimes thickening; rarely crepitus; head of humerus moves with the shaft. A positive diagnosis of this fracture, when only a small portion is broken and

Fig. 10. Fracture of the Neck of the Femur Near the Epiphyseal Line.

not widely separated, can be made only by the *x*-ray plate. (Fig. 9.)

No. 10.—Fracture of the Neck of the Femur in Children. This type differs in many respects from the same lesion in adults.

Fig. 12. Oblique Fracture of the Shaft of the Tibia in Children.

It is caused by a fall on the buttock, trochanter or feet. There is usually severe pain and loss of function of the hip for a short time, after which the patient may walk about with very little immediate disability except a slight limp. They are often

Fig. 11. Separation of the Lower Epiphysis of the Femur.

treated as sprains. The *x*-ray plates show a fracture that is often partial or greenstick and may be near the epiphyseal line. The later results are scoliosis, bad limp with limitation of abduction. These latter symptoms are caused by coxa vara and shortening. In the case shown in the illustration there was an inch and a half actual shortening caused by coxa vara and epiphyseal injury. (Fig. 10.)

No. 11.—Separation of the Lower Epiphysis of the Femur. This formidable but fortunately rare type is one with which all experienced surgeons are familiar.

Etiology.—Forcible extension of the knee.

Signs and Symptoms.—Shock; great injury to the soft structures; disturbed circulation from injury to the large vessels or nerves; characteristic deformity. The epiphysis with the thigh is thrown forward and the lower end of the shaft of the femur lies in the popliteal space. The x-ray should be used to differentiate from supracondyloid or "T" fractures of the femur and dislocation of the knee joint and to determine the exact character of the displacement. The illustration shows the most common deformity. (Fig. 11.)

FIG. 13. FRACTURE OF THE FIBULA, LOWER THIRD, AND SEPARATION OF THE LOWER EPIPHYSIS OF THE TIBIA.

No. 12.—Oblique Fracture of the Shaft of the Tibia in Children. This fracture of the lower third of the tibia in children is a definite type and presents certain characteristics which differ from the same fracture in adults. Localized tenderness and swelling with loss of function may be the only signs. A history of injury may not be obtained. The x-ray plates will show an oblique fracture of the tibia usually at the junction of the middle and lower third. The fracture may be linear or complete

FIG. 14. LONGITUDINAL FRACTURE OF THE TIBIA WITH FRACTURE OF THE FIBULA, LOWER THIRD, AND POSTERIOR DISPLACEMENT OF THE ASTRAGALUS.

with very little displacement. The writer has on several occasions seen these cases diagnosed sprain, contusion or periostitis. The x-ray will clear up the diagnosis and should always be used when a child pre-

FIG. 15. FRACTURE OF THE BASE OF THE FIFTH METATARSAL.

sents a painful and swollen leg with disinclination to weight-bearing, regardless of a history of injury or of other signs of fracture. (Fig. 12.)

No. 13.—Fracture of the Fibula, Lower Third, and Separation of the Lower Epiphysis of the Tibia. This is a definite type. It is the Pott's fracture of children. It has the same etiology, signs and symptoms as Pott's in adults except displacement of the astragalus and tearing of the internal lateral ligament, which do not occur in this injury. The illustration shows the characteristic deformity. (Fig. 13.)

No. 14.—Longitudinal Fracture of the Tibia with Fracture of the Fibula, Lower Third, and Postérior Displacement of the Astragalus. This is a rare type of Pott's fracture. It is a very difficult fracture to reduce properly and to retain the reduction. The illustration shows a two-year-old case of unreduced fracture of this type with healing of the fibula fracture and a new joint formed between the astragalus and the posterior portion of the lower end of the tibia at the site of the longitudinal fracture. This patient was walking on crutches two years after the injury and required operative treatment to correct the deformity. (Fig. 14.)

No. 15.—Fracture of the Base of the Fifth Metatarsal. This fracture is a definite type and is seen frequently. It was first described by Robert Jones in 1902. Although this is a common fracture few of the surgical text-books or special books on fractures give a description of it.

Etiology.—Inversion of the foot causing cross-strain against base of adjacent metatarsal bone and pull upon the peroneus brevus and tercius muscles. The fracture may be linear through the bone, anterior to the base, or an avulsion of posterior tip.

Signs and Symptoms.—Swelling; localized tenderness over site of fracture; ecchymosis. Patients are able to walk but have severe pain and are lame. They usually go to the doctor for treatment of sprained ankle. The *x*-ray plate shows the characteristic appearance shown in the illustration. (Fig. 15.)

CASE OF FUSED KIDNEYS

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THIS case of complete fusion of the kidneys was observed in the routine examination of the ureters with shadow catheters to locate a calculus, and afterwards proved by thorium injection.

The patient was a Russian, twenty-four years old, with a history of hematuria, dysuria and lumbar pains of two years' duration. Otherwise history was negative.

Physical examination was negative.

Cystoscopic examination showed the bladder and the ureteral orifices normal, and both ureters allowed passage of catheters for 30 centimeters. While the right kidney showed normal secretion and no "indigocarmin" in 30 minutes, the left kidney showed a decrease in the amount of urine and a fair "indigocarmin" in 15 minutes.

The first roentgen ray examination

FIG. 1.

showed a concretion, smooth and regular, the size of a nut, in the left lumbar region on a level with the 4th lumbar vertebra. (Fig. 1.) The kidney appeared markedly ptosed, and the concretion was diagnosed

FIG. 2.

as located in the pelvis of the left kidney.

A second roentgen ray examination, with shadow catheters, showed the catheters leaving the right and left orifices of the bladder normally, but at the right

FIG. 3.

sacro-iliac synchondrosis the right catheter turned over toward the left, and close to the left transverse process of the 4th lumbar vertebra it stopped just laterally to the calculus, while the catheter inserted in the left ureter continued up as far as the twelfth left rib. (Figs. 2 and 3.)

A third roentgen ray examination, with

FIG. 4.

injection of thorium into what was supposed to be the left ureter, showed the thorium to fill up what appeared to be a normal looking pelvis in the region of the twelfth left rib; the ureteral opening of the pelvis faced to the left. (Fig. 4.) The roentgen ray diagnosis was made of fusion of the kidneys with a concretion in the lower pole of what appears to be the pelvis of the right kidney.

The operative findings were enlarged kidney on the left side, representing a fusion of the left and right kidneys. The kidney was constricted at the junction of the middle and lower thirds. Both pelves came off anteriorly and the ureter of the upper pelvis passed anteriorly to the lower pole. The vessels of the lower pole came off from either the left common ilia or external iliac arteries. In the lower part was present a stone, about the size of a small nut, which was easily released.

The recovery was uneventful.

SOME EXPERIMENTS WITH COOLIDGE TUBES

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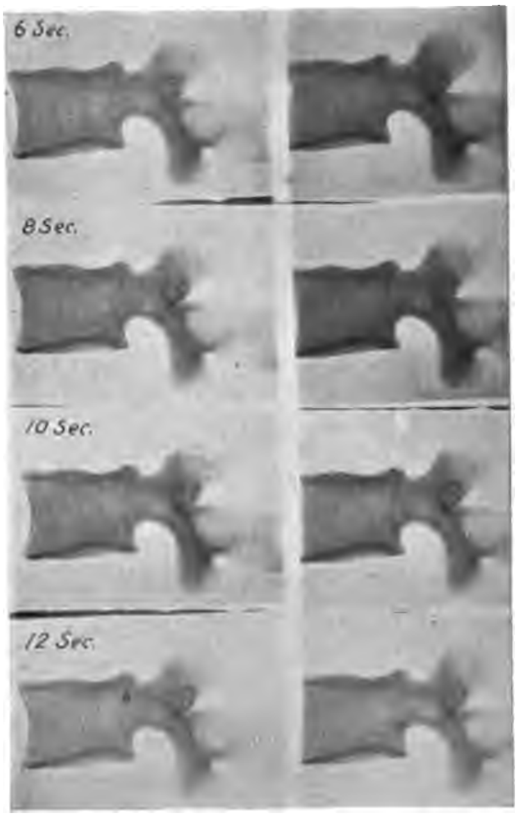
THE characteristics of the Coolidge tube have been carefully studied and described by such well qualified scientists as Dr. Coolidge and Dr. Shearer. The experiments set down in this article do not bring out any new points. They were performed merely with the idea of showing graphically some of the laws governing the operation of the various types of tubes. They have proved of some value in the selection of the proper focal spots for various kinds of work.

In testing out the radiographic results obtainable under varying conditions it is desirable to use some sort of test piece repeatedly. Such a test piece was prepared by imbedding a lumbar vertebra in a block of paraffin four and five-eighths inches thick. This block gave a radiogram practically identical with that obtained with a bone imbedded in living tissues. A piece of screen wire placed on top of the block was of great value in estimating differences of definition. In each experiment all of the exposures were made on one plate so that differences of development could not occur. A Snook transformer served as the source of energy. The different tubes were put into the tube stand one after another and the same apparatus used for all of the work.

EXPERIMENT NO. I

Object.—To study the influence of the size of the focal spot on photographic effect.

Parallel sets of radiograms of the test block were made, using the broad focus tube for one and the fine focus 10 milliampere radiator tube for the other. Both tubes were operated at a target distance of 26 inches with a current of 10 milliamperes and a 5-inch parallel gap. The exposure time was varied. Fig. I shows the results obtained. So long as the exposure time, machine settings, and tube distance were the same the photographic effects produced by the two tubes were approximately the same, regardless of the difference in the size of the focal spots. The



10 Ma. Radiator Tube   Broad Focus 7" Bulb

Fig 1. A Comparison of Broad and Fine Focus Tubes at a 26" Tube Distance each Carrying 10 Milliamperes with a 5" Parallel Gap.

slight differences in density observed in the eight second and ten second sets may have been due to slight errors in timing, since a pendulum was used for this purpose. This experiment also illustrates the wide difference in detail obtained with broad focus and fine focus tubes when they are operated

at the same distance. This difference may be eradicated by varying the tube distance of the broad focus tube.

EXPERIMENT NO. 2

Object.—To determine the effect of tube distance on the definition obtained with a broad focus tube operated at a 5-inch gap and carrying 80 milliamperes.

A series of exposures were made with the broad focus tube at different tube distances. Fig. II shows some of the radiograms obtained. As the distance between the target and the plate was increased the definition improved steadily. At 5 feet the detail was practically as good as that obtained with the 10 milliampere radiator tube at 26 inches.

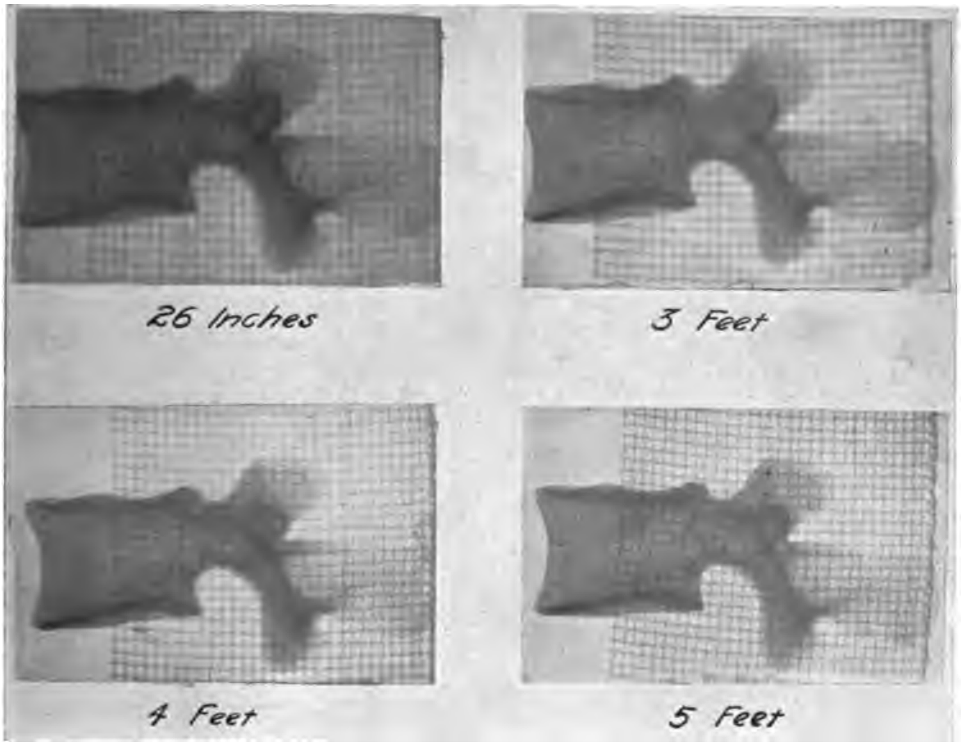


FIG. II. VARIATION OF DEFINITION WITH TUBE DISTANCE OBTAINED WITH THE BROAD FOCUS TUBE.

EXPERIMENT NO. 3

Object.—To determine the tube distances at which the same definition is obtained with the four types of tubes using the same parallel gap and exposure time and the maximum rated milliamperage in each case.

The Snook transformer was operated with a 5-inch parallel gap, and the radiator, fine focus, medium focus, and broad focus tubes received 10, 20, 40, and 80 milliamperes, respectively. Only the tube distance was varied and the exposure was three and one-half seconds in each case. Fig. III shows the results obtained. With the radiator, fine focus, medium focus, and broad focus tubes at distances of 26 inches, 3 feet, 4 feet and 5 feet, respectively, the definition was practically the same. This experiment was repeated with the test block 3 inches above the plate with the same results. The radiator tube produced less effect on the plate in three and one-half seconds than the larger tubes, but roughly speaking the photographic effect was the same for all of the four tubes. This experiment indicates that if the tube distances

are so adjusted that equally good plates are obtained with each of the four types of tubes one type is very little faster than another. It also shows that there is a definite relation between the size of the focal spot and the minimum tube distance at which the best definition is obtainable. The curve shown in Fig. IIIa was plotted from the data obtained in this experiment and shows that there is a direct proportion between size of focal spot and the minimum tube distance giving good definition. Dr. W. D. Coolidge was kind enough to furnish the data covering the sizes of the focal spots and to explain that the relation shown by this curve is a true one. The small tube operated at 26 inches produces considerable distortion, but this is not often an objectionable feature. It has been claimed that where it is necessary to make rapid exposures, as in the case of a crying child, the 10 milliampere radiator tube would be too slow to be of any value. The following experiment throws some light on this point.

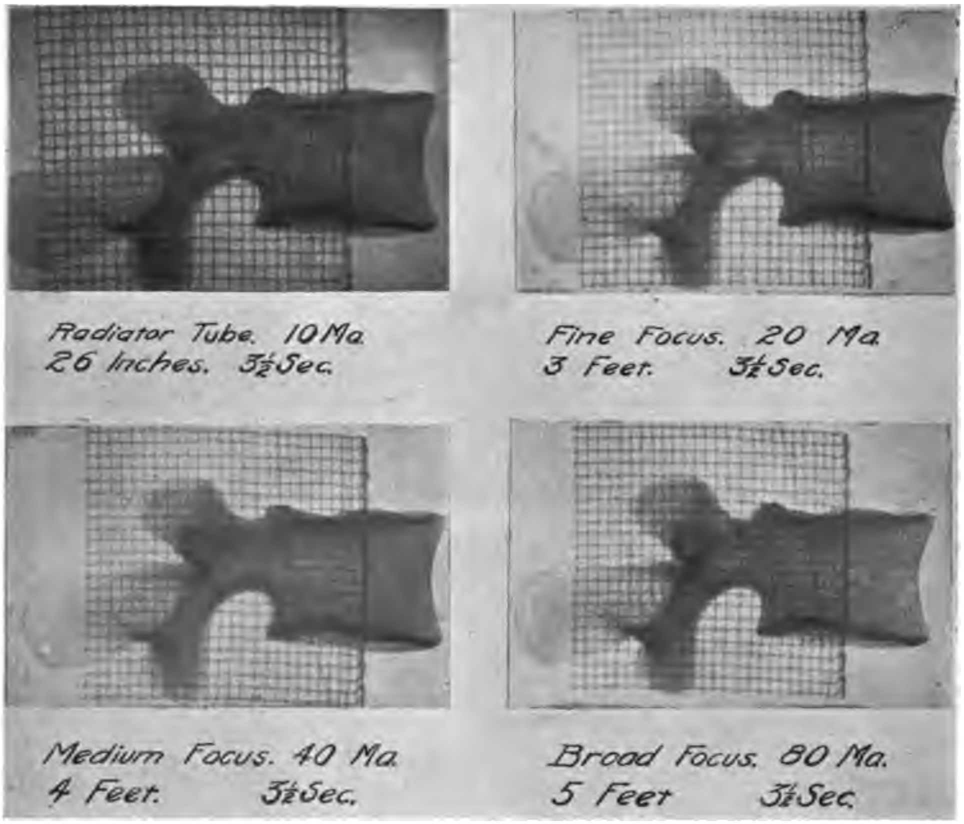


FIG. III. RADIOGRAMS MADE WITH THE FOUR TYPES OF TUBES WITH TUBE DISTANCES ADJUSTED SO AS TO GIVE APPROXIMATELY THE SAME DEFINITION IN EACH CASE.

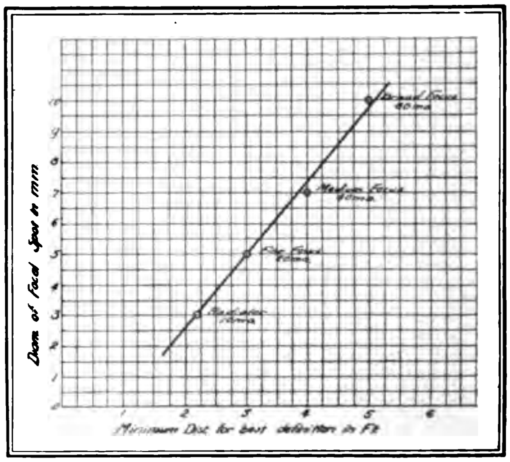


Fig. IIIa

EXPERIMENT NO. 4

Object.—To compare the exposure time required and the definition obtained with the small tube carrying 10 milliamperes used in conjunction with an intensifying screen and the broad focus tube carrying 80 milliamperes used without a screen, both tubes being operated at a 26 inch tube distance with the same parallel gap.

Fig. IV shows the results obtained. The radiograms made with the small tube and screen require less exposure for the same photographic effect and show decidedly better definition than those made with the broad focus tube at the same distance.

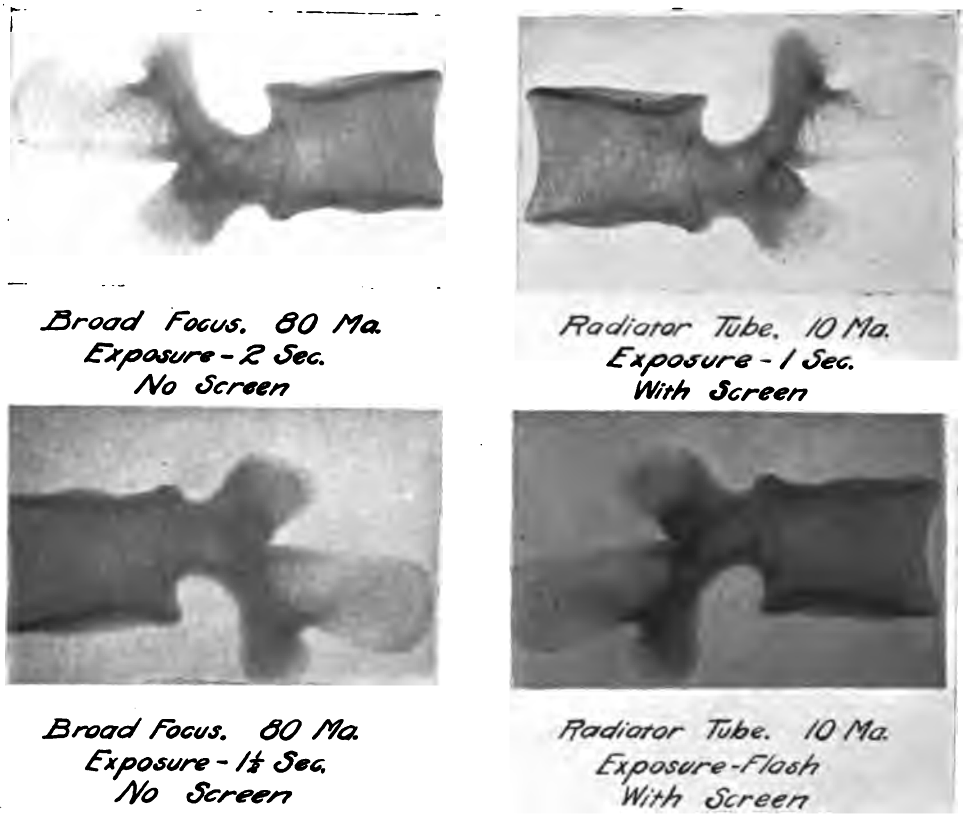


FIG. IV. COMPARISON OF THE BROAD FOCUS TUBE USED WITHOUT A SCREEN AND THE 10 MA. RADIATOR TUBE USED WITH A SCREEN AT A TUBE DISTANCE OF 26 INCHES.

SUMMARY

I. Variation of size of focal spot does not cause any variation in photographic effect so long as all the other conditions are constant.

II. When a given standard definition is to be obtained the exposure time is always approximately the same regardless of the size of the focal spot if the tubes are operated at their maximum rated milliamperage and the tube distances are properly adjusted.

III. The minimum distance at which the best definition is obtainable is directly proportional to the size of the focal spot.

IV. The 10 milliampere radiator type of tube used in conjunction with a screen at a 26 inch tube distance gives better definition in less time than a broad focus tube carrying 80 milliamperes placed at the same tube distance and used without a screen.

It would seem that where screens are available and the best possible definition is to be obtained, one type of tube has little advantage over another. The small 10 milliampere radiator tube seems to compare favorably with the older types designed for higher milliamperages.

SIGNIFICANCE OF ANNULAR SHADOWS*

BY WILLIAM A. EVANS, M.D.

DETROIT, MICH.

PREVIOUS to last year, it had been our custom to interpret all annular shadows on chest plates as cavities. In reporting several thousand cases during the preceding years, we had never questioned that an area of decreased density surrounded by an area of increased density should be considered other than a cavity. Of course, we had recognized pneumothoraces of the larger type, which were at times clinically and roentgenologically confused with cavity formation. We believe that the same interpretation of these shadows was made by other laboratories, because a complete review of the subject and a study of a large number of reproductions of chest plates did not reveal where any reference was made to a localized pneumothorax.

A review of roentgenograms recently published by Dunham in the Stereo-clinic failed to show that this question had been discussed, and in fact several cases described as showing cavity formation were in reality cases of localized air pockets. In making a report on a chest examination, last fall, we noted an annular shadow which we described as atypical of a cavity, but no suggestion was made that it might be a localized pneumothorax. There was a small amount of fluid present in the circumscribed area, this supporting the view that the condition was one of cavity formation. Plates made several weeks later of the same case showed a marked diminution in the size of the supposed cavity and showed the absence of fluid. This of necessity suggested that our first interpretation was an error.

FIG. 1. LOCALIZED PNEUMOTHORAX OPPOSITE THE CLAVICLE IN THE UPPER LEFT. NOTE DIFFUSE BILATERAL PARENCHYMAL TUBERCULOSIS.

FIG. 2. LARGE AIR POCKET IN THE UPPER LEFT LUNG FIELD. NOTE STRAIGHT LINE WHICH IS DEFINITELY INDICATIVE OF FLUID. INDISTINCT OUTLINES OF AIR POCKETS IN THE UPPER RIGHT.

A search of literature at this time brought to view an article published by Morris Fishburg, entitled "Localized Interlobar Pneumothorax Complicated with Pulmonary Tuberculosis," *Archives of Internal Medicine*, November, 1917, which covered quite fully the differential diagnosis between cavity formation and localized pneumothorax. About this time, we heard of Heise's and Sampson's work at the Trudeau Sanitarium, and during a visit at this institution we had the opportunity of seeing many plates showing annular cavities

*Read at the Nineteenth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chattanooga, Tenn., September, 1918.

which were correctly diagnosed as localized pneumothoraces. The Heise and Sampson article did not appear in print until four months following the presentation of this paper, but the author wishes to acknowledge the aid he received in a study of the subject under consideration during his visit to their laboratory.

The importance of this subject can hardly be overestimated, because there is a vast difference in the prognosis of a case showing a localized destruction of lung tissue and one showing localized collection of air between the pleuræ. Our inability or failure properly to interpret shadows resulting from a localized pneumothorax is undoubtedly the explanation of many of the differences in the roentgenological and physical diagnoses of chest conditions.

Localized air pockets are observed in both the peribronchial and parenchymal types of tuberculosis, the greater number being seen in peribronchial infection. The development of collections of air depends, first, upon a superficial involvement of lung tissue, the pathology either being interlobar or occurring in the parietal portions of the lung tissue. First, there is a pleuritis with or without fluid, and then an ulceration or rupture of the lung tissue, so that air escapes into the area of pleuritis. It was interesting to observe that one could prophesy from certain roentgen plates where a localized pneumothorax would be likely to develop owing to the superficiality of the lesion.

In making a differential diagnosis between cavity and localized pneumothorax, there are several aids. In the first place, the outline of the localized area of decreased density is irregular both as to contour and density, and it shades off gradually into the surrounding lung tissue, and practically all of the normal lung structure is observed throughout the area. One can also be guided in the correct interpretation of shadows by the pathology presented in other portions of the chest; for instance it would be quite unusual for a fibroid type of miliary tuberculosis to present a cavity, and it would be equally rare to find a cavity with the very common type of peribronchial tuberculosis. However, the most reliable method of differentiation between the two conditions is the obtaining of serial plates. While the changes in cavity formation from week to week is relatively nil, the changes in the localized pneumothoraces are quite marked even from week to week.

Fishburg in his article seemed quite con-

FIG. 3. TWO LARGE AIR POCKETS IN THE UPPER RIGHT LUNG; ONE IN UPPER LEFT. THE LOWER SHADOW ON THE RIGHT SIDE IS INTERLOBAR.

FIG. 4. LOCALIZED AIR POCKET IN THE UPPER LEFT NOTE A LATERAL PNEUMOTHORAX WHICH WAS DONE FOR THERAPEUTIC PURPOSES. THE LUNG DID NOT COLLAPSE AT THE SITE OF THE CIRCUMSCRIBED SHADOW OWING TO THE PLEURITIS.

fident that he could differentiate between the two conditions by the physical method of examination, but unquestionably a small sized localized air pocket gives no physical signs whatever, and this would be especially true in collections of air which form deep between the lobes of the lung.

The location of annular shadows will not serve as an aid in differential diagnoses, because the two lesions form with equal frequency in the same part of the chest; that is, the cavity forms more frequently in the upper lobes and pneumothoraces occur in the same location, but more especially between the lobes.

The clinical importance of air pockets is that they are evidence or a manifestation of a progressive tuberculosis; for it is evident that the lesion cannot develop unless there is ulceration or rupture of the lung tissue.

CALCIFICATION IN ANGIOMATA

BY HOWARD E. RUGGLES, M.D.

SAN FRANCISCO, CALIF.

THERE is a form of calcification appearing in hemangioma which apparently is not well recognized either pathologically or roentgenologically.

It appears in the form of multiple, small, cyst-like masses varying in diameter from a millimeter to a centimeter, or more, with a thin shell and an irregular mass in the center giving a plate which suggests encysted parasites. These spots are scattered through the growth, and probably represent calcification of thrombi in loops of the cavernous type of hemangioma.

Fig. 1. Case I.

The first case was observed in 1915 and reported in the *American Atlas of Stereoroentgenology* of December, 1916. One of the calcified nodules was removed, but the type of growth was not recognized at

Fig. 2. Case II.

operation. Examination of the specimen showed only a structureless mass of calcified material.

In the second case the site of this appearance was obvious, as it occurred in a large angioma below the left jaw. The clinical note reads: "Large angioma extending from behind the angle of the left jaw to the midline in front and downward into the neck for five centimeters." There was no operation in this case and the patient was lost track of.

FIG. 3. CASE III.

FIG. 4. CASE IV.

FIG. 5. CASE V.

Case III showed an angioma involving the palmar surface of the thumb, the thenar eminence, and extending upward above the wrist for several centimeters. The patient was treated with radium for

one and one-half years with slight diminution in the size of the growth. This case is of interest as it shows considerable deformity in the ulna and phalanges of the thumb as a result of pressure from the tumor growth.

Case IV showed an angioma over the right iliac crest running transversely, and another at the level of the tenth rib behind, extending from ten centimeters outside the midline to the axilla.

Case V was observed in the course of a routine examination of the left elbow, in search for the cause of slight indefinite pain in that region. There was no objective evidence of the tumor in this case.

In none of the cases was there evidence of similar masses elsewhere in the body. Aside from the deformity present in the cases with obvious tumor masses, the signs and symptoms were slight or negligible. The condition is apparently benign.

It is of interest to note that this type of growth also occurs in the liver and intestine, so that it is possible that similar shadows may be observed in those regions.

EXACT LOCALIZATION OF FOREIGN BODY OF SOME LENGTH BY THE FLUOROSCOPE

BY J. KAUFMAN, M.D.

BROOKLYN, N. Y.

IN extracting a foreign body of any length from the tissues by electro magnetic influence, it is of considerable importance for the surgeon to know its length, its obliquity, the point of emergence of its long axis from the skin, and the distance the proximal end is from this emergent point along its axis.

Even if magnetic extraction were not to to be used, these points would be of considerable value to the surgeon.

In Diagram I, the points in question are:

1. A–B, the length of foreign body.
2. < CAB, the angle the body makes with a horizontal plane (its obliquity).
3. S, the point at which the axis emerges from the skin.
4. A–S, The distance the proximal end, A, lies below S along the axis of A–B.

If these points were known, a magnet could be set at S, and the pull directed along A–B as an axis. Extraction with this setting would occasion a minimum of tissue trauma, and the extraction would be done with the maximum of efficiency.

If "nail extraction" were used, then a nail could be driven at S, at the obliquity of the body (< CAB), and for a distance equal to A–S. The end of the nail would then touch the body A–B at A, and it and the body would be in the same straight line. A magnetic pull could then be applied through the nail and extraction would be a comparatively simple matter.

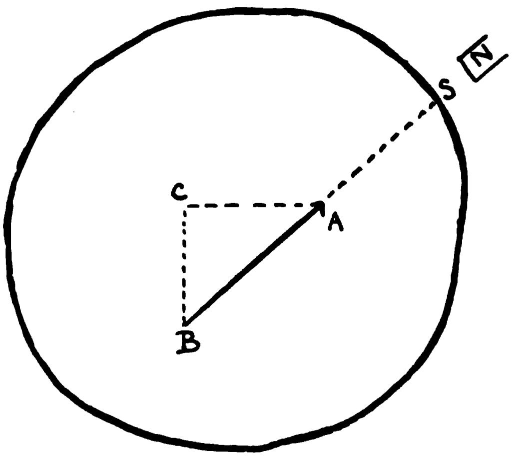


Diagram I

Let us first determine the length of the body (A–B), and its obliquity (< CAB). To comprehend readily the method of determination, it is necessary to refer to Diagram II.

S_a is first centered over the center of the screen.

S_b is then thrown on the screen, and the distance S_a–S_b is measured.

The distances S_a–A and S_b–B are determined. The Strohl (fixed angle) or any other method which gives direct distances accurately, may be used. At the same time 2–B and 1–A are determined.

The right angled triangle A′B′C′ (Diagram III) is constructed with A′–C′ equal to S_a–S_b (Diagram II) and C′–B′ equal to S_b–B minus S_a–A.

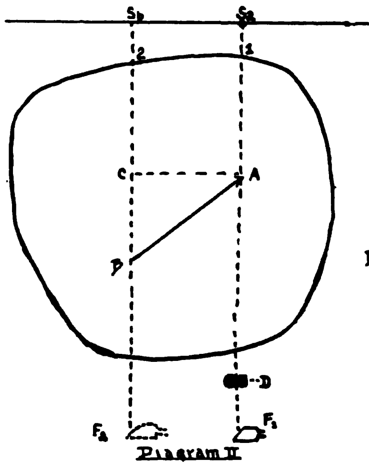
Triangles A′B′C′ and ABC are easily proved equal.

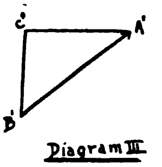
on the skin, knowing distances 2–B, and 1–A. (The parallax can be used conveniently. Arm O–P is set at the level of 2. Arm M–N is set so that "H," the distance between the arms, is equal to 2–B. 3 is then marked by pushing arm M–N against the skin. Point 4 can be marked in the same way.)

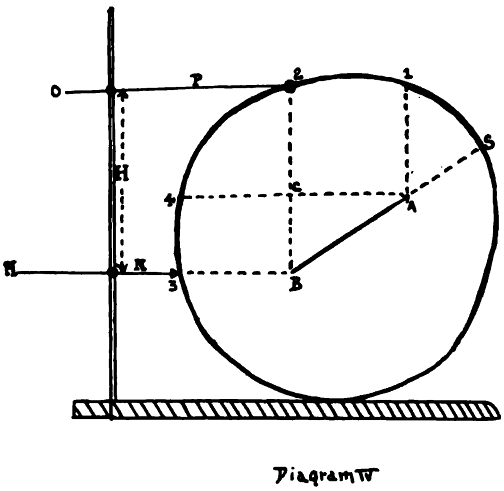
Points 3 and 4 need not be horizontal skin points, but may be vertical points of the ends of the body if the position of the parts is changed.

Having determined points 3 and 4, connect them and prolong this line.

Connect points 1 and 2, and prolong







KEY

Scr.	Screen.	S_a	Vertical shadow of A. (On center of screen, target at F_1.)
A–B	Foreign body.		
F_1	First position of target.	S_b	Vertical shadow of B, (target at F_2).
F_2	Second position of target.	S_a–A	Distance of A below screen.
D·	Diaphragm.		
S_b–B	Distance of B below screen.		
1—2	Skin markings.		

A′–B′ represents the length of the body.

Angle < C′A′B′ represents the angle it makes with the horizontal plane.

We have now determined the length and obliquity of A–B. Let us now determine S, the emergent point of its axis from the skin.

In Diagram IV, 1 and 2 represent the vertical projections of A and B. The horizontal projections, 3 and 4, can easily be marked

this line. The intersection of these two lines represents S. That this is so, requires but little thought. Two planes passed, one through A, B, 1 and 2, the other through A, B, 3 and 4, intersect along A–B.

Any two lines in these planes must intersect along A–B. (Two lines in any two intersecting planes can only intersect at the intersection of these planes.) Lines 1–2 and 3–4 lie in planes whose intersection is A–B, and their intersection, S, must, therefore, lie along this same axis.

S, therefore, represents the emergence of AB from the skin.

Now to determine distance S–A (the distance A lies below the emergent point of the axis, along this axis): This can easily

be done as follows: We make use of our original triangle A′ B′ C′ (see Diagram VI).

B′–2′ is made equal to B–2 (Diagram V).

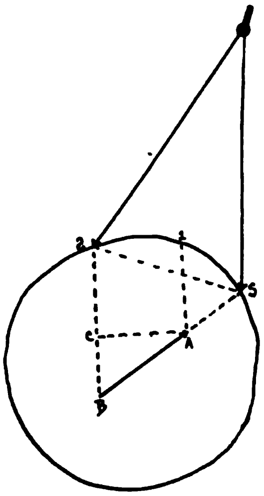


Diagram V

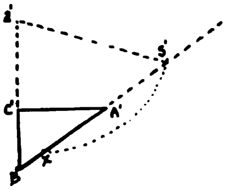


Diagram VI

Distance 2–S (Diagram V) is gotten by means of a compass.

With 2′ (Diagram VI) as a center, and 2–S as a radius, an arc is swung. It intersects B′–A′ at S′ (and also at X).

Triangles 2SB and 2′S′B′ are equal.

B′–S′ is equal to B–S.

A′–B′ is equal to A–B. (Proven in the original construction.)

A′–S′, therefore, is equal to A–S (the distance the proximal end A is from the projection).

[The point X should not be confusing. To check up which is the proper triangle, it is only necessary to place 2′–S′ parallel to 2–S, when 2′–B′ will be found to be vertical, as it should be. If 2′–X were placed parallel to 2–S, 2′–B′ would not be vertical. One can easily tell by the topography of the part which is the correct triangle without the above check.]

We have now determined each and every point required for an accurate localization of a body of some length, and we have done this solely by means of the fluoroscope. The body is now ready for removal by electromagnetic extraction, by dissection, or by a combination of both.

The writer is indebted to Captain E. S. Blaine, M.C., for his valuable assistance and cooperation.

DISCUSSION OF DR. W. H. B. AIKINS' PAPER

THE VALUE OF RADIUM IN CURING DISEASE, IN PROLONGING LIFE, AND IN ALLEVIATING DISTRESSING SYMPTOMS*

Dr. W. S. Newcomet, Philadelphia.—The first point I wish to touch upon is the word "cure." It has always been a sore point with me, as with Dr. Aikins. The word "cure" is hard to define, and it is still harder to decide when it can be properly used. Dr. Aikins has called attention to the fact that many of these patients have remained well for ten to fifteen years, but it must be remembered that many cases take from twenty to thirty years to run their natural course, and this is also true in cancer of the female breast. But that we get results in these cases there is not the least doubt, and if patients are clinically cured and have the sense of well being, that is sufficient. Some institutions have disallowed the word in their reports, but that is a matter of caution. In my opinion if they are clinically cured, that is sufficient, and warrants the use of the word.

Another point that is usually confused is the difference between emanation and the different rays. It should be remembered that the emanation is an element, just the same as copper and iron. The alpha, beta and gamma rays, if they be so regarded, come off during the change of these various elements. However, as to any selective action existing, the results obtained from the application of radium element, emanation, or the *x*-rays, are not so much due to the form of radiation used as to

*Published in the September, 1919, issue of The American Journal of Roentgenology.

the technic employed in its application. This is particularly well emphasized in the employment of radium in the treatment of uterine cancer, and of angiomata, both which troubles were treated some years ago without result.

You may think that the treatment of angiomata could not be regarded under the caption of life-saving; but if you had seen some infants that have been relieved of masses almost half the size of the infant's head located over the great vessels of the neck, all doubt would be removed.

In regard to the leukemias, I agree with Dr. Aikins again. I believe the results are better following radium than x-ray application. Quite a number of cases, perhaps somewhere around forty, were treated with both x-rays and radium, and I feel certain that the radium results, taken all in all, have been better than in those cases where the x-rays were employed.

A point (I don't know whether Dr. Aikins meant what he said or not) was on the matter of selecting and treating cases. While he spoke of it, it brought to mind a child who had a gland in the neck not long ago, which was treated by x-ray and promptly disappeared. The mass was easy enough to cure; but a little later this child developed trouble in the chest and it turned out to be sarcoma. There is no doubt that the tumor that was rayed in the beginning was a sarcoma and not a simple enlarged gland. For that reason, we have to be very careful in the selection of these cases. In some instances we can get better results with radiation than with operation, but unfortunately we do not know the character of the trouble until it has been removed and examined microscopically. This youngster would have had a far better chance for life had the proper course been pursued.

Not only is radium a life saver, but in those unfortunate cases that come to us for treatment where everything has been done, we can by its use do something to relieve their trouble and give them hope that there is a chance of being cured.

Dr. W. L. Clark, Philadelphia.—The longer I employ radium and see it used widely from the side lines, the more I am impressed with its great value. I believe, however, that men who have used radium should also be prepared to use other like methods, not only in the treatment of cancer but in other conditions, such as Dr. Aikins mentioned—the combination of roentgen rays, the electrothermic and the other methods. There are times when the violet rays do better than the x-rays, and times when the x-rays are better than the other. I have had an unusual experience in nevus vascularis. The results with radium were perfectly ideal, the scars are immaterial. We also get good results with the electrothermic methods. There is one type that has been very difficult to treat, and that is the very large cavernous type covered with perfect skin, with perhaps just a small rather elevated area of discoloration. A recent experience made me think some advance had been made. The best cases with radium require a long time. This case was passed upon by a radium man who thought that a good result might be obtained in the case, but not for a period of years. The people could not wait. We decided to use the coagulation method. A large angioma of the cheek, the size of a large orange, occupied the side of the face. We assured them that our needle would leave the skin unimpaired, the blood lake was coagulated and the lump came away in sections. The cheek had only a small scar left in the center and resumed its normal contour just like the other side.

Dr. Henry Schmitz, Chicago.—We have treated several cases of splenomyelogenous leukemia with radium. We noticed that we would very soon obtain a reduction in the size of the spleen, a decrease in the number of white blood corpuscles and a corresponding increase in the red blood corpuscles. Within four to six weeks the patient's blood picture was practically normal and the spleen markedly reduced in size. As soon as the latent action of the rays ceased, the spleen again grew larger and the typical blood picture returned. We then decided to remove the spleen. One case, a girl of fourteen, who had an enormous spleen, had a very speedy reduction in the size of the spleen from the action of the radium. But within six weeks the spleen again enlarged and the white corpuscles increased. We again subjected her to treatment and then removed the spleen. I did not see the patient for a while and was called one day and told that the patient was bleeding from the nose. The girl had a recurrence, and we then began to treat her over the region of the spleen in spite of the splenectomy. I do not think that splenectomy im-

proves a patient's chance for recovery, but it certainly renders them free from symptoms for a year or two. Furthermore, removal of the enormous sized spleen is surely a benefit to the patient.

Dr. D. T. Quigley, Omaha.—I came in late but I wish to say one thing which I think has a very important bearing on the splenomyelogenous leukemia. None of them have recovered; they have had recurrences and have died. I think the men who use *x*-rays get nearly as good results as those who use radium. I have one patient who has gone nearly three years without recurrence and the difference between that patient and the others is this: the patient who has gone for three years and has no sign of recurrence was treated by a country doctor who had read Barker's paper on the etiology of splenomyelogenous leukemia, in which he advanced the idea that these things were probably due to mouth infection. This country doctor treated the case, and the first thing he did was to have every tooth removed. The patient recovered and is well, and is the only patient I know who has gone over two years without recurrence.

Dr. H. K. Pancoast, Philadelphia.—I would recommend that extreme caution be observed in extracting teeth in leukemia patients, as it is frequently a dangerous procedure. We always warn dentists to be exceedingly careful in removing teeth in such patients, for there is very likely to be a severe hemorrhage.

The remarks of Dr. Schmitz relative to treating the area of the spleen after its removal seems like trying to get something for nothing. I do not see why the bone marrow of all the bones of the body should not be exposed. It undoubtedly produces a decided effect upon the leukemia; not so rapid perhaps as the treatment of the spleen, but a very definite effect, and we have always felt in the years since we first advocated doing it that our patients were somewhat better for having radiation of all the bones of the body. I do not see, however, how they can be helped by treating the area of the spleen after its removal. It may have some influence on the blood cells.

(Dr. Schmitz stated that in the case of the little girl all of the bones were treated.)

Dr. Leda J. Stacy, Rochester, Minn.—I know nothing of the radiation of the splenic area after removal of the spleen. Our idea in treating the splenic area is for the reaction on the blood, because after removing the spleen there has not been found the increased connective tissue following a heavy dose of radium and reduction in the size of the spleen.

Dr. Douglas Quick, New York.—Treating the long bones with *x*-rays in connection with radium over the spleen has been our plan at the Memorial Hospital, and we think that this has a greater degree of permanence than treating over the spleen alone. I remember one case in which treatment over the spleen produced such intense nausea that we had to use the treatment over the long bones entirely and not over the spleen at all; but we got good results. The patient remained well for nearly three years. The spleen was reduced in size just as in other cases.

In regard to the question of the blood stream, I don't know whether it is safe for me to mention at this time some work that we have been doing. It is the injection of the active deposit of radium intravenously, and we have had some very spectacular results so far. The time has been too short to draw any definite conclusions; but in some of these cases we have had some very marked changes in the blood pictures and reduction in the mass. One patient of Dr. Janeway's, a case of lymphatic leukemia with generalized enlargement of the glands, had a very prompt reduction of the glands, so that they were not palpable; but that was only four or five months ago. Another case was a lymphosarcoma with an abdominal mass and inguinal, axillary, and cervical nodes, one of which was removed for section and found to be a lymphosarcoma. In that case with radium over the mass and injection of the radium we had splendid results. Those are just two instances of a number of cases we had tried this method on in the last few months. It is something new and we do not know where we are just yet, but the results obtained are encouraging and interesting.

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TWENTIETH ANNUAL MEETING OF

THE AMERICAN ROENTGEN RAY SOCIETY

The Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY was held September 3–6, 1919, at the Grand Union Hotel, Saratoga Springs, New York. It seemed to be the consensus of opinion of those who attended that this was the most interesting of any of the meetings of the Society. In point of attendance, the registration showed a larger number of members present than ever before. The Program Committee and the Local Committee of Arrangements are certainly to be congratulated on having secured the presentation of so many papers of distinct educational value and on having made such complete arrangements for the comfort of those in attendance. A large number of guests were registered, and the large hall at which the sessions were held was well filled from the first paper until the last.

Many features combined to contribute to the general success, namely, the perfect weather which prevailed and the fact that the accommodations were so commodious that there was no crowding. Future committees would do well to bear this point in mind, inasmuch as a large meeting hall contributes indirectly to the comfort and success of the meeting.

Among the agreeable features presented were the side trips, which were carefully planned and splendidly carried out. The first trip was a visit to the Research Laboratory of the General Electric Company at Schenectady, New York. Members and guests left at noon by special trolley cars, and on their arrival at Schenectady were given a buffet lunch, after which the afternoon was spent in the Research Laboratory. The most admirable arrangements were made for the demonstration of the features of the laboratory and of the manufacture of *x*-ray tubes. Small parties of about twenty were made up, each with a guide, so that adequate explanations were given *en route*. Furthermore, each visitor was provided with a typewritten description of the features of each department. In this way everyone was able to realize every detail that was being exhibited.

A second trip was made to the Metropolitan Life Insurance Company Sanatorium, at Mount McGregor, New York.

The guests had the opportunity of seeing the beautiful buildings of the Company and to enjoy the magnificent views presented from different points of the ascent of the mountain and also from the various viewpoints about the Sanatorium. A very interesting feature was the visit to the Grant Cottage, where are still preserved many of the relics and souvenirs of the last days of President Grant. Dr. Howk, the Director, presented many interesting lantern slides typifying the progress of tuberculosis in some of the cases under treatment.

Friday evening, September 5th, Dr. W. T. Bovie of the Cancer Commission of Harvard University, Boston, delivered a lecture which will be long remembered by those who had the good fortune to listen. It was abundantly illustrated by lantern slides, and while the subject matter was new to many of his listeners, the lecture started out with simple statements which were gradually elaborated, and in this manner held the attention of his audience even through the more technical parts of his address.

Practically all of the papers which were listed in the program were presented and abundantly illustrated by lantern slides. The fact that the auditorium was of good size with high ceilings and was adequately darkened for the demonstration of the slides were points which contributed to maintaining the interest. Special notice must be taken of the paper presented by Dr. William H. Stewart and Dr. Arthur Stein, entitled: "Roentgen Ray Study of the Abdominal Organs Following Inflation of the Peritoneal Cavity with Oxygen." Dr. Stewart reported a series of 37 cases and illustrated the technique of the introduction of oxygen into the peritoneal cavity and the brilliant plates obtained by furnishing a gaseous background for the various solid abdominal organs. It was the opinion of many that this work marks the beginning of a distinct era in roentgen diagnosis second in importance only to the introduction of the opaque meal in gastrointestinal studies.

Members who were interested in treatment enjoyed the symposium on Goiter and its Roentgen Treatment. The symposiums on the Heart, with papers by Drs. Lewald, Van Zwaluwenburg and Holmes, were of great interest. The papers which took up the roentgen ray work in the Canadian and American Armies by Colonel Wilson and Colonel Johnston respectively, were also much appreciated. The symposium on Bone Disease, participated in by Drs. Murphy, Evans, Bowman, Moore, and Cotton, was very instructive. Dr. George C. Johnston demonstrated a new device for preventing accidents from high tension current during radiographic and radiotherapeutic exposures which excited much comment. Another interesting demonstration was made by Dr. Heck of a simple type of Stereoscopic Fluoroscope.

Particularly interesting from a technical standpoint was the presentation by Dr. W. D. Coolidge of Schenectady, N. Y., of a new piece of apparatus in which the *x*-ray tube of small dimensions is mounted inside the transformer box so that the tube and transformer form a single enclosed unit. The principles shown in this new type of apparatus, which is still in the process of development, would seem to forecast a revolution in future types of fluoroscope tables and radiographic tube stands.

The annual dinner held on the evening of Thursday, September 4th, was well attended. Dr. Bowen acted as toastmaster. Among the speakers of the evening were Dr. A. W. Crane of Kalamazoo, Dr. P. M. Hickey of Detroit, Dr. Pirie of Montreal, Dr. James T. Case of Battle Creek, Dr. Arthur C. Christie of Washington, Dr. George C. Johnston of Pittsburgh, Colonel Wilson of Toronto. The after dinner dance was much enjoyed, especially by the ladies in attendance.

One of the important features of the business session was the establishment of an Eastern, Middle and Western section, with provision for sectional government under the auspices of the parent society. It is planned that these sections will each hold mid-winter meetings at points most

convenient for the membership. A number of new members were admitted, and the following officers were elected for the ensuing year:

President: Dr. James T. Case, Battle Creek, Michigan; First Vice President: Dr. M. P. Burnham, San Francisco, California; Second Vice President: Dr. Stanton Heck, Salem, Ohio. Dr. G. W. Grier was reelected Secretary and Dr. W. A. Evans of Detroit was again made Treasurer. Mr. H. W. Dachtler was made Librarian and Historian for the ensuing year. Dr. Alexander B. Moore was chosen as a member of the Executive Committee. Drs. Jaches and Bowen were placed on the Publication Committee.

The publication of the papers read at the meeting will commence in the November number of THE JOURNAL.

P. M. H.

The Program of the Meeting was as follows:

PROGRAM

Wednesday Morning, in the Casino
Opening Session at 9.30

Welcome: By the Local Committee; Dr. Earl H. King, Chairman.

Response: By Dr. David R. Bowen, President.

Symposium—Technical:

A Simple Localizing Fluoroscope (Illustrated): Dr. Edwin C. Ernst, St. Louis.

A High Tension Terminal Guard (Illustrated): Dr. George C. Johnston, Pittsburgh.

A Stereoscopic Fluoroscope (Illustrated): Dr. Stanton Heck, Salem, Ohio.

Teleroentgenography of the Head (Illustrated): Dr. Preston M. Hickey, Detroit.

Physical Investigation Work in Progress on Tubes and Accessories: Dr. W. D. Coolidge, Schenectady, N. Y.

Intensifying Screen Efficiency: Millard B. Hodgson, Rochester, N. Y. (by invitation).

Wednesday Afternoon at 2.00

Symposium—Bone Diseases:

Dislocation of the innominate Bone: Dr. John T. Murphy, Toledo.

Multiple Myeloma of Bones: Dr. William A. Evans, Detroit.

Coccidioidal Granuloma (Illustrated): Dr. William B. Bowman, Los Angeles.

The Roentgen Study of Metastatic Malignancy in Bones (Illustrated): Dr. Alexander B. Moore, Rochester, Minn.

Further Observations of Myxoma of Bone, with Report of Second Case of Myxoma of the Femur (Illustrated): Dr. Albertus Cotton, and Dr. Standish McCleary, Baltimore, Md.

Thursday Morning at 9.00, *in the Casino*

The Aviator's Heart (Illustrated): Dr. L. T. Le Wald, New York.

A Plea for the Use of the Fluoroscope in the Examination of the Heart and Great Vessels (Illustrated): Dr. James G. Van Zwaluwenburg, Ann Arbor, Mich.

The Roentgen Findings in Pericarditis: Dr. George W. Holmes, Boston, Mass.

Discussion of papers of Drs. Le Wald, Van Zwaluwenburg and Holmes.

The Development of Radiography in the Canadian Army Medical Corps during the Great War: Dr. Robert Wilson, Colonel C.A.M.C., Toronto.

Roentgen Ray Work in the United States Army: Dr. George C. Johnston, Colonel M.C., U.S.A., Pittsburgh, Pa.

Discussion of papers of Col. Wilson and Col. Johnston.

Thursday Afternoon

Thursday afternoon was spent in the Research Laboratory of the General Electric Company at Schenectady, N. Y.

Thursday Evening at 8.00

Annual Dinner, Main Dining Room, Grand Union Hotel: Members, Ladies, Visitors.

Friday Morning at 9.00, in the Casino

Symposium—Therapy and Physiological Action:

A Report of Two Cases of Xeroderma Pigmentosum with Malignancy of the Eyeball Successfully Treated by the Roentgen Ray: Dr. George W. Grier, Pittsburgh, Pa.

Treatment of Goiter by Radiotherapy: Dr. Russell H. Boggs, Pittsburgh, Pa.

A Consideration of the Treatment of Diseases of the Thyroid with Special Reference to the so-called Hyperthyroidisms: Dr. John A. Lichty, Pittsburgh, Pa. (By invitation.)

Some Physiological Effects Produced by Radiating Definite Regions within a Single Cell: Dr. W. T. Bovie, of The Cancer Commission of Harvard University, Boston, Mass. (By invitation.)

Friday Afternoon at 2.30

At the Auditorium of The Metropolitan Life Insurance Company Sanatorium, Mt. McGregor, N. Y.

Symposium—Lung and Thorax Conditions.

Sanitorium Management of Tuberculous Patients with Special Reference to the Demonstration of Progressive and Receding Tuberculosis as Shown by Roentgen Ray Studies: Dr. Horace J. Howk, Metropolitan Life Insurance Company Sanatorium, Mt. McGregor, N. Y. (By invitation.)

Analysis of 1300 Cases Referred for Gastrointestinal Study, with Special Reference to the Importance of Chest Examination of Such Cases: Dr. Thomas A. Groover and Dr. Arthur C. Christie, Washington, D. C.

Encapsulated Effusion in Chest (Illustrated): Dr. Leopold Jaches, and Dr. Harry Wessler, New York.

The Influenza Epidemic, a Clinical, Pathological, and Serial X-Ray Study (Illustrated): Dr. John Hunter Selby, Major, M.C., U.S.A., Washington, and Dr. Joseph Harkavy, New York.

Malignant Disease of the Lung, Its Early Recognition and Progressive Development (Illustrated): Dr. George E. Pfahler, Philadelphia, Pa.

Late Results of War Injuries of the Chest: Dr. Henry J. Walton, Baltimore, Md.

Friday Evening at 8.30, in the Casino

Lantern Slide Demonstration.

Saturday Morning at 9.00, in the Casino

Roentgen Ray Studies of the Seminal Vesicles and Vasa Deferentia after Urethroscopic Injection of the Ejaculatory Ducts with Thorium: Dr. Charles A. Waters, Baltimore, Md.

The Technic of Radio-surgery with Special Reference to Adaptation to Civil Life: Dr. James T. Case, Battle Creek, Mich.

Anatomic Roentgen Ray Diagnostic Lines (Illustrated): Dr. Edward H. Skinner, Kansas City, Mo.

The Early Roentgen Ray Diagnosis of Ulcerative Tuberculous Colitis (Illustrated): Dr. Lawrason Brown, Trudeau, N. Y. (By invitation.)

Roentgen Ray Study of the Abdominal Organs Following Inflation of the Peritoneal Cavity with Oxygen: Dr. William H. Stewart, and Dr. Arthur Stein, New York.

At this session the following papers will be read by title.

The Open Method of Surgery in Deep Seated Recurrent Cancer, Preparatory to Roentgen Ray and Radium Therapy: Dr. Emil G. Beck, Chicago, Ill. *Technic for this Type of Treatment:* Dr. Paul Eisen, Chicago, Ill. *Patent Ductus Arteriosus (Botalli):* Dr. Maximilian J. Hubeny, Chicago, Ill. *Some Observations on the Roentgenographic Findings in a Series of Chests Examined in a Base Hospital in France:* Dr. Francis F. Borzell, Philadelphia, Pa.

NOTICE

A number of unidentified slides were found after the Meeting in various rooms at the Grand Union Hotel. These have been sent to the office of The American Journal of Roentgenology, and the owners are requested to communicate with the publisher.

Pacific Coast Society Proceedings

The regular semi-annual meeting of the Pacific Coast Roentgen Ray Society took place at the Hotel St. Catherine, Catalina Island, on May 29 and 30, 1919, and was one of the best attended meetings the Society has yet had, due largely to the return of many members from military service.

The meeting was called to order by Dr. C. M. Richards, Vice-President, in the absence of the president, Dr. H. H. Boardman.

The following papers were presented during the two days session.

"Personal Observations of a Roentgenologist in the A. E. F.," W. B. Bowman, Los Angeles; "Delayed Roentgen Reactions," Howard E. Ruggles, San Francisco; "Localization of Foreign Bodies in the Eye," W. Warner Watkins, Phoenix, Arizona; "Barium Stasis in the Common Duct," Roy A. Payne, Portland, Oregon; "A Preliminary Report on Certain Appendix Problems," H. H. Heylman, Long Beach, California; "The Roentgenologic Aspect of Bone Lesions," Lyell C. Kinney, San Diego; "A Case of Bullet in Heart Muscle and Recovery," F. C. Swearengen, Pomona, Calif.; "The Roentgenologist vs. the Radiographer," Chas. W. Stewart, Los Angeles; "Roentgen and Radium Reactions," Albert Soiland, Los Angeles; "Endothelioma of Chest; Postmortem Findings," A. C. Siefert, Oakland, Calif.

The following officers were elected for the ensuing year:

President, Dr. W. B. Bowman, Los Angeles.

Vice-President, Dr. M. P. Burnham, San Francisco.

Secretary-Treasurer, Dr. C. M. Richards, San José.

Executive Committee, Drs. Albert Soiland, L. C. Kinney, W. W. Boardman.

A most delightful feature of the meeting was the trip from San Pedro to Catalina and return as the guests of Dr. Soiland on his commodious yacht, "Viking III."

The following new members were elected: Dr. A. C. Seifert, Oakland, Calif.; Dr. R. J. Taylor, Los Angeles; Dr. R. A. Payne, Portland, Oregon; Dr. O. R. Stafford, Los Angeles; Dr. Llewellyn Jones, San Francisco; Dr. Charles W. Stewart, Los Angeles.

Chas. M. Richards,
Secretary.

Extract from Inspection of Medical Services with the American Expeditionary Forces

Roentgenology.

In all the hospitals visited we found complete equipment for x-ray work, under the supervision of specially trained experts. As in our base hospitals in this country, this is one of the most effective and practical features of the present expansion of the Army Medical Department. The findings of the expert roentgenologist are recorded and followed by the military surgeon and internist in the diagnosis of disease, in the localization of foreign bodies (projectiles) and injuries, and in determining the site of operation. This work is a most valuable adjunct to military medicine and surgery. The order, system and scientific arrangement of the radiological services visited was impressive. There are x-ray establishments in the evacuation hospitals and even in the field hospitals, as well as at the base. The x-ray room in the field hospital at Thiaucourt was found to be located in the subcellar, the unit being almost constantly under bombardment. The mobile x-ray units are a special feature of this work and the personnel of these units are frequently under fire.

TRANSLATIONS & ABSTRACTS

The following is an editorial in the June 15, 1919, number of the *Journal of the Indiana State Medical Association*. It puts the case so very aptly that the Editor wishes to present it *in toto*.

ROENTGENOLOGY A SPECIALTY

The development of roentgenology, and especially the practical uses to which the roentgen ray may be put as an aid in the diagnosis and treatment of diseased conditions, has resulted in a widespread sale of roentgen ray outfits to doctors and dentists of every description. As might be expected, the real value of roentgenology has been distorted and perverted through the ignorance and lack of experience of many men who have used their roentgen ray outfits as a means of broadening their sphere of activity but without properly appreciating the fact that roentgenology is a specialty in itself, and one that requires a long apprenticeship of study and experience before it can serve efficiently and well as an adjunct to the successful practice of medicine or dentistry. The average man who owns a roentgen ray outfit merely dabbles and makes a bad mess in the practice of what really is a highly specialized science, and while he develops a few facts in the simpler cases which aid him in his general work, in a far greater number of cases he arrives at erroneous conclusions as a direct result of his lack of technic and lack of experience in interpreting his results. In fact, to the average physician many roentgen ray plates are a camouflage through which he never penetrates.

To our notion roentgen ray work, like other highly specialized work, should be in the hands of not only those who devote the most of their time to it, but of those who have equipped themselves with the latest and best apparatus and who through training and experience are best able to apply intelligently the apparatus they possess and properly interpret the results. We realize that we are treading on the toes of a lot of men who are dabbling in roentgen ray work when we advocate specialism in roentgenology, but we feel that the sooner medical men realize and appreciate their limitations the better it will be for themselves as well as the public. Furthermore, to the man who is especially interested in roentgenology the way is open for the acquirement of skill and experience through apprenticeship under those who are recognized as specialists in the work.

There is an old saying that the man who attempts to do everything does nothing well, and it applies to the profession of medicine as well as it applies to a trade. Roentgenology is a specialty, and if we are to get the most out of roentgenology for the benefit of the profession as well as for the benefit of suffering humanity we must for the most part depend on the specialist in roentgenology for results; and this applies not only to the application of the principles of roentgenology, but to the interpretation of the results. There are many roentgen-ray plates that even a layman can interpret, but, on the other hand, there are many other roentgen-ray plates that must be interpreted by the man of wide experience and intensive training.

HOFER, G. Osteomyelitis of the Frontal Sinus. (*Monatschr. f. Ohrenkrank u. Lar-Rhinol.*, 1917, Nos. 11 and 12.)

Hofer reports an interesting case of a patient who showed a swelling the size of a thumb over the supero-internal aspect of the left orbit which was painless but depressible on pressure. The ocular globe was forced outward and downward. Vision was good and the fundus oculi normal. There was pus in both the left and right middle floor of the nose. Radiological diagnosis was osteomyelitis or new growth of the left frontal sinus. Operation exposed a large purulent cavity communicating with the left frontal sinus and in which a nonadherent sequestrum was floating which had become detached from the lower wall of the sinus. The posterior wall of the sinus was scraped in three places, while the right frontal sinus and both ethmoidal and sphenoidal sinuses were cleansed. Recovery. In a second case the patient presented a tumor the size of a hen's egg below the left eye. Operation showed that the lower and anterior walls of the frontal sinus were completely necrosed with the presence of nonadherent sequestra. There was also a sequestrum from the posterior wall of the right sinus. Death in forty-eight hours. Necropsy revealed

an acute edema of the brain, pyencephalitis and an acute meningitis of the base and convex aspect of the brain. The osteomyelitis was the result of pus retention; the inflammation of the mucosa and development of polypi on the mucous membrane prevented the flow of pus from the sinus.

Weil, P. E., and Loiseleur. Roentgen Exploration of Effusions in Serous Membranes. (*Presse méd.*, Paris. Dec. 3, 1917, Vol. XXV, No. 67, p. 683. Ref. *J. Am. M. Assn.*, Feb. 9, 1918.)

Weil and Loiseleur give roentgenograms showing the instructive findings when air is injected into a joint or the pleura, pericardium, vaginalis or peritoneum, after evacuation of an effusion. There are no untoward by-effects, and the air shows the distention of the parts, the laxity of the joint capsule, etc., and the presence of free bodies in a joint. In tuberculous pleurisy and pericarditis, the injection of air in the place of the effusion has a direct therapeutic action, besides rendering roentgenoscopy possible and distinct. In one case of tuberculous seropurulent and hemorrhagic pericarditis, the young patient has been clinically cured for the eight months since eight applications of paracentesis and insufflation of air in the course of seven months. When the effusion recurs, the presence of the air forces it down into the lower part where it is most readily accessible by subxiphoid puncture. They inject as much air as the amount of effusion withdrawn.

Bensaude, R., and Guenaux, G. Roentgen Diagnosis of Cancer of the Large Intestine. (*Arch. de méd. de l'appar. digest.*, etc., Paris. May, IX, No. 4, p. 179. Concluded. Ref. *J. Am. M. Assn.*, July 14, 1917.)

The conclusions of this long analysis of thirty cases are that the roentgen rays may locate the lesion but that they are unable to specify its nature. Gaps in the shadow merely indicate circumscribed induration of the wall of the bowel; this may be due to ileocecal tuberculosis or ulcerative colitis as well as to cancer. Bensaude and Guénaux have noticed, however, that with the latter the shadow may spread out in the shape of the flame of a candle. They have never seen this except with cancer verified by operation (transverse colon). Another typical finding with cancer is when the shadow narrows to a small bridge between two broad shadows, looking as if a chunk had been gouged out on each side. The shadows cast by overlapping loops may hide a typical gap or narrowing in the shadow; this is particularly liable with the sigmoid flexure. They comment on other difficulties with radiologic exploration of the large intestine, but add that it may give valuable information in regard to the functioning of an anastomosis, warning of recurrence and demonstrating postoperative adhesions and the advisability of further intervention. In four of the thirty cases on which the article is based, the cancer was discovered in such an early stage that its eradication was possible. A shadow of the rectum, dotted with lithe spots, was obtained in a case of polyposis of the rectum.

Villandre, C. Radiography of the Skull and its Interpretation. (*J. de radiol. et d'électrol.*, Paris. March–April, III, No. 8, p. 507. Ref. *J. Am. M. Assn.*, July 14, 1917.)

Villandre has been studying on prepared skulls or parts of skulls the solution of certain problems raised during interpretation of numerous radiograms of skull wounds. The brain fits exactly into the skull, and knowledge of the skeletal points throws light on the conformation of the brain and its various parts. He took radiograms of the brains with lead threads placed to outline the corpus callosum, the ventricles, etc. A composite outline picture thus obtained is placed on the radiographic plate. By this means the shadow cast by the projectile fits into the proper region of the skull.

Nogier, T. Radiotherapy plus Operation in Treatment of Cancer. (*J. de radiol. et d'électrol.*, Paris. March-April, III, No. 8, p. 515. Ref. *J. Am. M. Assn.*, July 14, 1917.)

Nogier says he has been appalled at the histologic findings of cancer cells scattered through the adjoining tissues after apparently complete excision of cancers. Particularly in the breast, improved technic has revealed cells sown through the tissue far back of the primary tumor. They are not seen nor felt, and lie

latent till after the operation. This arouses them, and we have recurrence of the cancer. For this and other reasons he advocates broad and intensive radiotherapy before the operation, preoperative instead of postoperative roentgen or radium exposures. This he insists will prove successful beyond anything yet realized to date. Working with Regaud, he has conclusively demonstrated, he reiterates, that it is possible to give enormous doses of filtered roentgen rays, leaving the skin intact. They expose the cancer first, then the adjoining regions, and especially the lymph glands which are ordinarily invaded. The operation should be as early as possible, removing all the microscopically evident malignant tissue. The scattered cancer cells lose all power for reproduction under the exposures, and if any embolism occurs during the following operation the embolus is sterile and metastasis is not entailed. The cells in the depths having lost their power of reproduction, die off sooner or later and are absorbed. This absorption of cancer cells serves as an immunizing process. All the evidence therefore, he concludes, is overwhelmingly in favor of radiotherapy followed by excision as the logical treatment for cancer.

STACY. Radium Treatment of Menorrhagia. (*Minnesota Med.*, 1919, II, 88. Ref. *Progress Med. Sci.*, 720.)

Stacy has summarized the experiences with radium under these conditions as found in the Mayo Clinic, where this element has been used in 1915 in the treatment of the menorrhagia of the menopause, in cases which presented no gross pelvic lesion, and in those presenting a fibroid but with contra-indication to operation. Since then the types of cases treated have been increased, and now radium is considered the treatment of choice in all cases of the menorrhagia of the menopause in which the presence of carcinoma is definitely excluded, either by history or by a diagnostic curettement, and in those cases not presenting a large, soft myoma which is apt later to undergo degeneration. The radium is also used in cases of profuse menstruation of the young woman (1) when there is a small submucous fibroid, (2) when no gross pathological condition is demonstrable, and (3) in cases presenting a large myoma in which there is a definite surgical risk. However, they have not entirely replaced myomectomy with radium for the treatment of myomas in the patients between the ages of thirty and forty years. Of the 175 patients that were treated with radium from August, 1915, to December, 1917, there were 2 under twenty years of age, 34 from twenty-one to thirty years, 45 from thirty-one to forty, 91 from forty-one to fifty, and 14 were more than fifty years of age. Of this number 93 had had previous curettements, 37 had had more than one curettement, and 56 had undergone other pelvic operations. In 69 cases there were complications that were considered as relative, though not in every instance absolute contra-indications to operation. There were heart lesions in 34 cases, hypertension in 8, kidney lesion in 11, obesity in 8, and pulmonary tuberculosis in 6. Seventy-seven of the 175 cases had definitely palpable fibroids and it is interesting to note that 155 of the 175 patients were married women, and that of these only 25 had not been pregnant. The dosage of radium is gauged by the age of the patient, and by the presence or absence of a tumor. In the young person without a demonstrable tumor and when it is desirable to continue menstruation, usually one application of 50 mg. of radium element from four to six hours is used. In older persons in whom it is desirable to stop menstruation entirely, it has been found that an exposure of 50 mg. for from ten to twelve hours has brought about the desired results. In cases in which large dosage is used, menstruation is usually irregular for about two months and ceases entirely after the second or third month; following the lighter exposures, it becomes regular and normal in most instances in about two months. It is the custom in the Mayo Clinic not to repeat the treatment until an interval of three months has elapsed. If, after that time, menorrhagia continues, a second treatment is given, and with the exception of one case, the second treatment has been effective. In this instance menstruation ceased for one year, and then became profuse and the periods prolonged. It has been necessary to give second treatments in 10 instances in this series. In 8 instances a hysterectomy was done later, but only one of these 8 patients had been given a second radium treatment. Included in this series is one case of adenomyoma of the uterus, in which a microscopic diagnosis was made at the time of the exploratory incision,

but the tumor entirely disappeared after one intra-uterine and four abdominal treatments. Reports have been received from 143 of the 175 patients and in 55 (38.5 per cent) menstruation had ceased, not to return to the date of the report. In only 14 patients did menstruation cease immediately following the treatment. In 15 menstruation ceased for three months and returned, in 29 (20 per cent) the menstruation became normal; in 42 it was reported as regular but somewhat profuse and in 30 it became profuse. Ninety-two patients reported their condition as improved, and 27 as not improved.

STROHL, A. The Resistance of the Human Body to the Electric Current. (*J. de radiol. et d'électrol.*, Par. May, 1919, Vol. III, No. 5, p. 193. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 207.)

Strohl remarks that most of the methods of electrodiagnosis presuppose an invariable resistance on the part of the tissues to the electric current. But this resistance is not invariable. It depends on a number of variable factors, as he explains in detail, with suggestions how to eliminate various causes of error.

AUBOURG, P. (*J. de radiol. et d'électrol.*, Par. May, 1919, Vol. III, No. 5, p. 193. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 217.)

Aubourg reports the case of a radiologist who had always used most scrupulously the current means of protection in his thirteen years of roentgen work, even to a doubly protected glove for the left hand. But in 1912 chronic lesions developed on his hands. He kept at his work during the war, often making long exposures in restricted quarters. In two years he had thus aided in extraction of 4,000 foreign bodies. The chronic dermatitis was then treated once a month with carbon dioxid snow, applied for forty seconds at each sitting to one, two or three of the foci. The focus was then treated with bismuth held in place with a gauze bandage. This dressing was left undisturbed for ten or fifteen days. The eschar dropped off the fifteenth to the seventeenth day, and by the end of two months there was not even a trace of a scar. During the entire course of treatment the hands were kept well greased at night with a soothing salve. In thirteen months twenty-three lesions were thus treated and twenty-one subsided smoothly; one started to suppurate but this was at once aborted with magnesium chlorid, according to P. Delbet's technic. One other lesion returned at the end of three months as a wart on the spot that had been treated and had disappeared. This recurring lesion rapidly progressed but was treated and soon healed like the others. There was also a warty growth on the left forearm which looked so suspicious that excision was recommended for this, but it disappeared spontaneously while the other lesions were being treated. One would have to look close now to suspect that the hands were the hands of a radiologist. The carbon dioxid treatment did not interfere with his continuing his work; its efficacy is apparently established by the year and a half that has elapsed since. The case teaches further that the most painstaking care to avoid danger is not always effectual, as we cannot rely implicitly on the protecting devices at our disposal.

WEIL, E. A. Roentgen Treatment of Uterine Fibroma. (*An. de la Facultad de Med.*, Montevideo. Jan.-Feb., 1919, Vol. IV, No. 1–2, p. 21, Ref. *J. Am. M. Assn.*, July 19, 1919, p. 234.)

Weil remarks that no one thinks of holding modern surgery responsible for the mishaps before the asepsis era. But many medical men still hold aloof from roentgen treatment of uterine fibromas on account of mishaps they have heard of occurring in the early days of roentgen work. He claims that F. de Courmelles of France was the first to report (Jan. 11, 1904) the application of the roentgen rays in this field, and time has demonstrated the value of cross-fire exposures from a dozen different points more or less. Each field is about 10 cm. and the distance from the anticathode is 20 or 22 cm. at least. He filters through aluminum at least 1 cm. thick, utilizing only the shortest possible waves of the Coolidge tube. His smallest dose is 10 H units of the hardest possible rays, with a 22 or 24 cm. spark. The chromometer gage is 11 Benoist. He marks each field with a demographic pencil and exposes each field once or twice, going over them all successively on consecutive

days. Then he recommences the exposures after an interval of at least a month. The most puzzling problem is when to recommence the exposures. He usually gives four series of exposures, but after the first two he leaves an interval of at least five weeks. The course thus lasts six months, but the menopause becomes installed and the pains much improved during the second month. He cites Pfender's statistics showing that less than 2 per cent of uterine fibromas display a tendency to malignancy, while the global mortality from operative treatment of uterine fibromas is at least 5 per cent. He reiterates that roentgen therapy should now be the rule and operations the exception for all uterine fibromas, even the painful and the hemorrhagic ones, except that easily removable pedunculated myomas and those of exceptionally rapid growth should be removed without delay.

HARRIS. Radium in Diseases of the Ear. (*Tr. Am. Otol. Soc.*, Vol. XIV, Part II.)

Harris concludes, as a result of an extended investigation, that radium, up to the present time, has failed to be of any considerable benefit in the treatment of diseases of the ear. So far as chronic deafness is concerned it has proved virtually a failure. In the rare cases of intractable tinnitus and excessive vertigo, on the one hand, it can be employed with a reasonable hope of relief by its power of destroying the labyrinth. Finally, so far as malignant growths are concerned, it is of value when they are superficially seated. When deep seated there is nothing sufficiently encouraging to be said of it to warrant its use to the exclusion of operative measures when they can with propriety be adopted. The work that has already been done with it on the ear is not sufficient to condemn it *in toto*, however, and it is to be hoped that other investigators will take it up and give it further thorough and careful trial.

BRAASCH, W. F., M.D., and OLSON, F. A., M.D. Rochester, Minn. Roentgenographic Diagnosis in Renal Tuberculosis. (*Surg., Gynec. & Obst.*, Vol. XXVIII, No. 6.)

American writers have not recognized the importance of *x*-ray examination, while European workers on the contrary have used it very extensively. At the Mayo Clinic a complete *x*-ray examination is made in every case of suspected renal tuberculosis.

"The frequency with which positive data may be obtained in the roentgenogram is evidenced by the fact that in the years 1916 and 1917 131 patients were operated on for renal tuberculosis, and roentgenographic examination of the urinary tract had been made of all. Of this number positive shadows suggestive of renal tuberculosis were found in thirty patients, a percentage of twenty-two. It may be stated, therefore, that approximately one out of five patients with renal tuberculosis will have positive roentgenographic data of definite diagnostic value. Such data are of particular value in conditions as follows:

"1. When, because of the contracted condition of the bladder or impassable stricture of the ureter, the cystoscopic findings are inadequate.

"2. When the cystoscopic findings are not typical of renal tuberculosis.

"3. When the clinical findings are not suggestive of renal tuberculosis or of any involvement of the urinary tract, as may occur with a closed tuberculous pyonephrosis.

"4. In the presence of bilateral renal tuberculosis, when the typical shadows frequently render cystoscopy or further clinical examination unnecessary."

The shadows are due to deposits of calcium in T.B. areas and assume a variety of forms.

"They may be differentiated from a stone shadow by (1) the variability in its density, as the shadow is irregularly concentrated in different portions; (2) by a shadow of lesser density throughout than that usually observed with stone; and (3) by its irregular and indefinite outline. The calcareous area may, however, simulate the shadow of a renal stone in every particular, and it may be quite impossible to differentiate it without further clinical data. The same is true of renal stones that are occasionally seen of such consistency that the shadow will be fully as irregular and hazy in outline as a typical tuberculous shadow. It may be said, however, that approximately 75 per cent of tuberculous renal shadows may be recognized as such in the roentgenogram."

Cross section of the removed kidney shows that the shadows are due to deposits of lime encrusting the ends of the calices and to caseated areas containing sufficient deposits of cal-

cium to cast a shadow. These shadows are classified in groups:

"(1) Multiple scattered small areas, (2) single or a few localized areas of one centimeter or more in diameter, and (3) large irregular, diffuse areas involving either a large portion or the entire kidney.

"In the first group the small scattered areas are generally caused by lime deposits. They are occasionally seen singly, and appear as elongated, irregular faint streaks, or as multiple punctate areas, scattered over a large portion of the kidney, usually in one of the poles. Unless the renal area in the roentgenogram is carefully examined such areas may easily be overlooked.

"The second group representing single or several isolated areas of concentrated calcareous deposit is the type most easily confused with stone. The shadows are usually of several varieties: (1) a shadow of irregular outline with a consistency dimmer than that seen with renal stone and varying in size from 1 to 3 or 4 cm.; (2) a shadow characterized by great irregularity in its consistency and outline, somewhat resembling filigree work; and (3) definite shadows with a density and contour suggestive of stone. The size of the shadow in no way indicates the extent of the tuberculous lesion. A shadow of only a centimeter or two in diameter may be present in a tuberculous lesion involving the entire pole or even the complete kidney.

"The third group is characterized by large, regular rounded shadows of variable density in their various portions. As a rule, on section, the kidney is of a putty-like consistency in the area which causes the shadow. It is, however, impossible to say from the appearance of such caseated areas whether or not a shadow will be present in the roentgenogram. In two caseated areas of similar appearance one may cast a shadow and the other none at all. Occasionally the calcium deposit is so slight that a soft diffuse shadow will be seen only on careful plate reading, and it may be easily confused with similar shadows cast by the bowel.

"Shadows caused by complete caseation of the kidney are most striking. They may assume the outline of a complete cast of the kidney and are usually irregularly lobulated. The shadow may vary in density in different portions of the kidney, some of which may be so dim as to be scarcely discernible, while others may be definitely and strikingly outlined. Occasionally, with complete or extensive calcification, the calcium deposit may be so slight that the x-ray simulates that of accentuated normal renal outline, and it may be difficult to determine whether or not it is an actual pathologic shadow.

"Actual renal stone formation is rare in tuberculous kidney. When it does occur it is generally a phosphatic stone, formed in a localized abscess with necrosis and secondary infection. We have observed this in several cases. Stone formation in the opposite kidney in cases in which a tuberculous kidney had been removed occurred in but two instances that came under our observation. One patient passed a small renal calculus from his remaining kidney two years after the other kidney had been removed for tuberculosis. It may be inferred that primary stone formation is unusual in patients with renal tuberculosis."

These T.B. shadows must be differentiated from renal calculi, intestine contents, gall stones, calcareous deposits in glands in perirenal tissue in the pleura.

"Ureteral shadow: Calcareous deposit may occur with tuberculosis in the ureter, although less frequently than in the kidney. When it is present a considerable portion of the ureter, usually the lower portion, is involved. The shadow may be several centimeters or more in length and outline the dilated ureter to a greater or less extent. The shadow is caused either by calcareous deposits in the thickened wall of the ureter or by intra-ureteral calcareous deposits. Such deposits are generally accompanied by similar caseation in the kidney. Considerable peri-ureteritis may accompany this calcification of the ureteral wall. The peri-ureteral infiltration together with the thickened ureter will often cause a tumor-mass which can easily be palpated on rectal or vaginal examination. Often calcified glands in the bony pelvis will cast shadows suggestive of either stone or tuberculous deposits in the lower ureter. They, however, usually occur with no clinical evidence of tuberculosis in the urinary tract or other portions of the body, and are therefore of no diagnostic significance."

The irregular wavy outline which was formerly considered as very important is regarded as unimportant. The x-ray examination is especially valuable in bilateral involvements. This may be important if a T. B. shadow is

found on one side only. This is especially true if one side is chronic and the other acute. "If the bladder is in such a state that it is impossible to make a satisfactory cystoscopic examination a shadow of calcification in one kidney area might be of considerable diagnostic value. This is illustrated in conditions as follows: (1) when the healthy kidney has been catheterized and it is impossible to find or catheterize the other side; (2) when neither meatus is found but the patient's general condition and the renal functional tests indicate the existence of one healthy kidney; and (3) when evidence of disease is found in the kidney that is catheterized, and there is a shadow of calcification in the kidney which cannot be catheterized."

The shadows in the pelvic outline as shown by the pylogram which are regarded as characterized by T.B. are one or more of the following: (1) irregular inflammatory dilatation of the pelvis, (2) areas of cortical necrosis, and (3) stricture in the ureter.

Inflammatory dilatation of the pelvis as the result of tuberculosis in its early stages is largely confined to the calyces. The dilatation is differentiated from ordinary inflammatory dilatation by the greater irregularity in outline of the calyces and by the variability of degree of dilatation among the different calyces. A peculiarity often noticed is marked dilatation at the uretero-pelvic juncture.

When the process is advanced, so as to cause necrosis of the renal parenchyma adjacent to the calyces, the pelvic outline becomes irregular and indistinct to a variable degree. When the necrotic areas are confined to one or two calyces the outline of the latter will have a moth-eaten appearance at the apices, and the pyelographic medium is visible as a hazy shadow extending into the parenchyma. When the necrotic process is advanced it may either assume irregular forms scattered through the parenchyma or it may coalesce to form a large irregular sac.

Occasionally the outline of the necrotic area is apparently detached from the pelvis or connected with it by a narrow isthmus. When the area of necrosis is confined largely to the cortex and is not directly communicating with the pelvis, the pelvic outline may occasionally become contracted in a manner resembling certain forms of pyelonephritis.

As a result of the infective process in the kidney, inflammatory dilatation of the ureter will follow and may be demonstrated in the ureterogram. Should the ureteral mucosa become ulcerated, however, and a stricture ensue, mechanical dilatation may also be present. Ureteral dilatation resulting from tuberculous stricture in the ureter may be confused with that resulting from a benign stricture, or obscure lithiasis. If the clinical and cystoscopic findings are insufficient with which to identify the lesion, pyelography will usually demonstrate abnormality in the pelvic outline that is suggestive of tuberculosis.

The cystogram may also occasionally be of diagnostic value. This is particularly true when it is impossible to find either one meatus or both. The bladder outline will be variably contracted and usually more in one half of the bladder. The demonstration of a dilated ureter by making a cystogram with the patient in the Trendelenburg position is suggestive of renal involvement on that side. Demonstration of a widely dilated internal bladder, sphincter and posterior urethra in the presence of a severe cystitis is also suggestive of tuberculosis.

CONCLUSIONS

1. The value of roentgenographic diagnosis of renal tuberculosis does not appear to be fully appreciated.

2. Routine roentgenography in every case in which there is evidence of infection in the urinary tract is advisable.

3. Shadows may be found in approximately 20 per cent of patients with renal tuberculosis. Such shadows may require the aid of cystoscopic data in their interpretation.

4. Positive evidence of tuberculosis may be obtained by this method when all other clinical data fail, and when cystoscopic examination is impossible.

5. Shadows due to renal tuberculosis may be arranged into three definite groups.

6. Caseated areas in the ureter and prostate may also be outlined.

7. Pyelography is occasionally valuable (1) in the identification of renal infections of doubtful nature, and (2) in the identification of doubtful shadows in the renal area.

8. The cystogram may also give data of value.

Balfour, D. C., M.D., F.A.C.S., Rochester, Minn. Polyposis of the Stomach. (*Surg., Gynec. & Obst.*, Vol. XXVIII, No. 5.)

The patient, a male, thirty-four years of age, presented the first case in which this condition was found in the Mayo Clinic in approximately 69,000 operations, 8,000 of which were for gastric lesions. He came to the Clinic November 8, 1918, because of stomach trouble. A careful elicitation of the history disclosed relevant facts as follows: In 1910 the patient began to have periods of unexplained loss of appetite; during the following five years this periodic anorexia was a great annoyance. The symptom which finally brought him to the Clinic, pain with an empty stomach, first manifested itself in 1915. For a short time after its onset the pain showed some periodicity, but during the greater part of the three years it has occurred daily. The patient described the pain as a cramp beginning in the right and in the left hypochondrium and radiating toward the midline of the epigastrium; it was not associated with burning or with the

Fig. 1. (250518). The Mottled Appearance (dark areas) in the Roentgenogram are Shadows due to the Polypi in the Stomach.

usual subjective symptoms of hyperacidity, although it occurred only when the stomach was empty. He further stated that the stomach seemed to empty very rapidly and that the period of freedom from cramps after the ingestion of food had become increasingly shorter. By frequent eating he had kept his distress at a minimum and his nutrition was practically normal. There had been no nausea or vomiting or evidence of gastric bleeding. The patient had been discharged from the army in 1917 on a diagnosis of pulmonary tuberculosis, and after five weeks in a sanitarium home treatment was maintained until June, 1918.

"The physical examination did not disclose any abnormal findings. There were no evidences of pulmonary lesion either clinically or by *x*-ray and the Wassermann test was negative. The test meal showed an absence of free hydrochloric acid and the presence of a considerable quantity of epithelium. This achylia explained in a measure the symptoms of which the patient complained, and considered with the character of the gastric pain and the fact that it had been continuous over a period of almost three years practically excluded gastric or duodenal ulcer. The only clue which led to preoperative diagnosis, was secured by *x*-ray examination. The entire pyloric end of the stomach exhibited a diffuse mottled appearance, apparently well demarcated both at the pylorus, and at a line about 4 inches from the pylorus. Dr. Carman, after a re-ray at which any possibility of complicating factors, such as the patient's having taken food before the examination, was excluded, made a diagnosis of gastric polyposis.

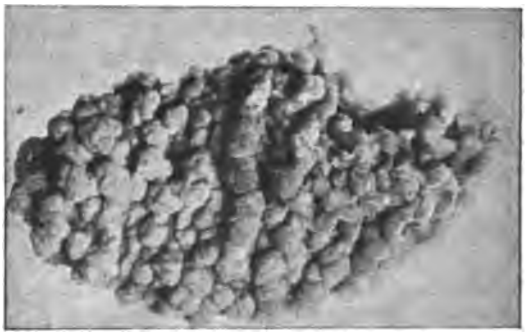

Fig. 2. Photograph of Specimen.

"The operation was done on November 19th by Dr. Sistrunk. On inspection the stomach was found to be normal in appearance; on palpation, however, a soft doughy thickening of its wall extending from the pylorus to a line about 5 inches above was immediately evident, and although this did not give the sensation

of an actual tumor, the lines of demarcation were quite definite and corresponded with those apparent in the roentgenograph. Resection was carried out along these lines; about two-fifths of the stomach was removed."

A section of the gastric wall containing a tumor examined microscopically showed the bulk of the tumor to be composed of a tremendously hypertrophied mucous membrane. No hyperplasia of glandular element was of a character to suggest malignancy.

Bloomfield, Arthur L., and Waters, C. A. The Correlation of *X*-ray Findings and Physical Signs in the Chest in Uncomplicated Epidemic Influenza. (*Bulletin of The Johns Hopkins Hospital*, Vol. 30, No. 3421.)

The exact significance of lung lesions in epidemic influenza is a disputed question. The opinion is held that bronchopneumonia, while occurring with or following influenza, was not an essential feature of the disease but a complication. It seems possible that small pneumonic areas may exist without signs. The present study was undertaken to see if an *x*-ray examination could throw light on the question.

The material consisted of sixteen consecutive cases of uncomplicated epidemic influenza treated in the wards of The Johns Hopkins Hospital during January and February, 1919. The diagnosis was based on the symptoms, the hyperemic phenomena of skin and mucous membranes, the course of the disease, the duration of the fever, and the presence of leucopenia. In no case was there any evidence of pulmonary complications—the lungs remained clear throughout on physical examination, and cough, if present, was dry and productive only of the usual slight mucoid expectoration associated with the hyperemia of the mucosa of the upper respiratory tract.

Roentgenographic examination of the chest was made as soon as possible after admission and thereafter at two or three-day intervals until the patient was discharged. Each series of plates was studied with two points in mind—first to discover and interpret any abnormal markings, and secondly, to determine any variations in the pulmonary shadows during the course of the disease.

RESULTS

In no case was there any detectable change in the appearance of the lung markings in a series of from three to six plates made at various times during the febrile and post-febrile convalescent stages of the disease. It would seem, therefore, that the markings were permanent or at least unassociated with the immediate acute disease. In no case was any shadow seen which could be interpreted as indicating a solidification of the lung. The usual grades of root shadows, in some cases small areas of probable calcification (glands?) resulting from infections prior to the influenza, and in others slight degrees of apical clouding were seen. It is not the present purpose to discuss the exact significance of pulmonary shadows in general.

CONCLUSIONS

1. Repeated roentgenographic examinations of the lungs during the course of clinically uncomplicated cases of epidemic influenza showed only permanent lung markings.

2. These findings support the clinical impression that bronchopneumonia is a complication and not an essential feature of the disease.

Kaufman, Louis René, M.D., F.A.C.S., Attending Surgeon, Flower Hospital, New York. Chronic Gastric Ulcer. *The International Journal of Surgery.*

Great stress is laid upon an *x*-ray study of the stomach. Special emphasis is placed upon the serial method. The importance of team work between the clinical staff and the surgeon is emphasized so that they all speak the same language. They soon establish a technic in their study of cases which permits fairly accurate work in distinguishing between chronic appendicitis, adhesions, and numerous other conditions, to be differentiated before operation.

Members and Guests Attending the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY at Saratoga Springs, N. Y., September, 1919.

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ROENTGEN RAY STUDY OF THE ABDOMINAL ORGANS FOLLOWING OXYGEN INFLATION OF THE PERITONEAL CAVITY * †

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AND
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NEW YORK CITY

MOST of us are familiar with the fact that roentgen ray examination of the body cavities after the introduction of air or gas intensifies the shadows of soft parts, bringing out details that cannot be obtained by any other method. This procedure has been repeatedly employed as a diagnostic aid in the examination of the urinary bladder, of the renal pelvices and of the knee joint. In 1914 Dr. W. H. Stewart and Dr. W. L. Luckett of New York demonstrated roentgenographically the ventricles of the brain in a case of fracture of the skull where air had invaded the interior. This experience has since been used practically by Dr. W. E. Dandy of Baltimore, who describes a method of outlining roentgenographically the cerebral ventricles by injecting air into the cavities of the brain. He has found this technique of great value in the diagnosis of hydrocephalus and other intracranial conditions.

Credit for the original idea of air inflation of the peritoneal cavity in conjunction with roentgen ray examinations must be given to Kelling, who employed it in 1902 in two human beings, one a case of ascites, the other a carcinoma of the stomach.

Eight years later in 1910 and 1911 Jacobaeus of Stockholm revived the method and emphasized the safety of the abdominal puncture on a basis of over twenty experiments on cadavers, in which a trocar was pushed through the abdominal wall and invariably reached the peritoneal cavity without damaging the viscera. Excellent results were obtained by him in seventeen cases of abdominal conditions, including the diagnosis of a metastatic nodule in the liver, gastric cancer, and general carcinosis of the intestine. A monograph on the subject of laparo- and thoracoscopy under air inflation was published by him in 1913, wherein conditions are described as relatively favorable in the living subject, because of the yielding and elastic character of the intestinal walls.

In January, 1912, Weber, working in the

*Read in part before the American Association for Thoracic Surgery, June 9, American Gastro-enterological Society, June 10, and the American Surgical Association, June 16, 1919. Preliminary report published in *Annals of Surgery*, July, 1919.
†Read at the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3-6, 1919.

Private Institute for Roentgen Diagnosis of Drs. Eugene Weber and V. von Bergman of Kies, conceived the idea, based on the roentgen examination of a bladder filled with oxygen showing good detail of a hypertrophied prostate, that the introduction of sterile inactive oxygen or air into the abdominal cavity might help to render visible a number of organs, tumors, and abdominal areas which heretofore had been more or less inaccessible to the roentgen ray examination. Experiments on animals and fresh cadavers of children confirmed this theory. His roentgenograms showed that the following viscera and areas may be rendered visible by means of gas inflation of the abdomen: The liver and spleen as a whole, including the region of the gall bladder; coils of the large and small intestines without bismuth filling; the pyloric end of the stomach; the wall of the stomach and large intestines with gas contents; the bladder filled with urine; parts of the mesentery; the subphrenic space, not readily accessible to diagnosis, and many abdominal tumors. He emphasized the far-reaching importance of air or oxygen inflation of the abdominal cavity for experimental and diagnostic roentgenology, and laid stress on the value of the method for obtaining good roentgenograms of the liver and biliary region, as well as for the roentgenographic representations of tumors and inflammatory swellings.

FIG. 1. READY FOR THE PUNCTURE. Freezing of the spot with ethyl chlorid. FIG. 2. NEEDLE INSERTED AND THE PLUG BEING WITHDRAWN. FIG. 3. NEEDLE CONNECTED WITH THE TUBE AND OXYGEN BEING INFLATED. The nurse is seen slowly opening the oxygen tank. FIG. 4. INFLATION COMPLETED. Note the difference in the distention of abdomen between this plate and No. 1.

During the same year, Lorey in con-

nection with the demonstration of a peculiar case of ascites pointed out that after the introduction of air or nitrogen into the abdominal cavity, it was possible to demonstrate the contour of the spleen

FIG. 5. POSITION NO. 1. Position of the patient and apparatus to obtain best detail of the diaphragm, liver, gallbladder and spleen.

and liver with great detail, and to recognize the presence of tumors projecting above the surface as well as other pathological changes. The method was employed by him after abdominal paracentesis in a case of hepatic cirrhosis with good results.

Systematic experiments for the purpose of rendering the liver accessible to roentgenology were carried out in 1914 by Rautenberg, who introduced air by puncture into the abdominal cavity in diseases of the liver, complicated by ascites. He recommended the method as affording remarkable information concerning the organs situated below the diaphragm. Conditions such as carcinoma of the liver, sarcoma of the spleen, etc., were recognized by this procedure. He contributes four interesting illustrations of lesions of this character.

Meyer-Betz in a communication during 1914 discussed the clinical importance of roentgenographic representation of the liver by means of air or oxygen inflation of the peritoneal cavity. He called attention to the fact that correctly employed

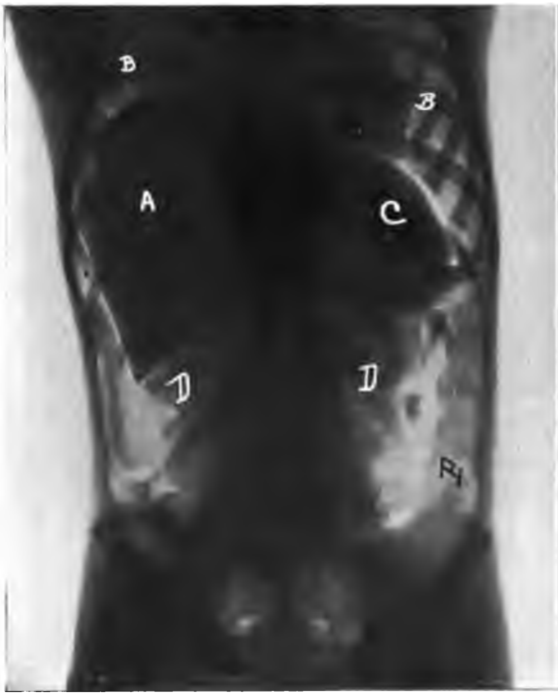

FIG. 6. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Spleen; *D*. Coils of small intestines; *E*. Descending colon.

FIG. 7. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Spleen; *D*. Gallbladder; *E*. Barium-filled splenic flexure.

this procedure affords valuable assistance in the early diagnosis of abdominal tumors and their relation to the other organs in the abdominal cavity.

In November, 1918, Goetze, in apparent ignorance of the former work on this subject with the exception of Rautenberg, reported very remarkable roentgenographic results concerning nearly all of the abdominal organs, obtained by filling the peritoneal cavity with oxygen before making the roentgen examination.

diaphragm into the liver. Fluoroscopically the projectile was seen to rise and fall with the apparently normal diaphragmatic excursions. There were no evidences of pleural adhesions. Surgical procedure by Dr. Willy Meyer revealed the bullet lying in the liver just beneath the perforated diaphragm. This case was presented before the New York Thoracic Society. During the discussion Dr. Howard Lilienthal of New York suggested that the lung could have been excluded by producing

FIG. 8. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Spleen and pedicle; *D*. Right kidney; *E*. Left kidney.

FIG. 9. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Left lobe liver; *D*. Spleen and pedicle; *E*. Enlarged mesenteric glands.

The latest contribution to this subject is made by A. Schmidt who, in February, 1919, published an article confirming the opinion of former authors as to the value of this method.

The occasion which particularly called our attention to this work was a case of gun shot wound of the chest. In attempting to localize the bullet we had difficulty in ascertaining whether it was located in the lower lobe of the lung, embedded in the diaphragm, or had passed through the

an artificial pneumothorax, the bullet, if in the lower portion of the lung, would have receded from the diaphragm with the pulmonary collapse. If this could be done, we saw no reason why the presence of the bullet in the liver could not be determined by producing a pneumoperitoneum, feeling confident that air or oxygen would separate the diaphragm from the liver. After reviewing the literature on the subject we determined to try the method, using oxygen as suggested.

We have examined altogether 37 cases, the results of which investigations have been somewhat startling. Not only did we find the diaphragm completely separated from the liver and obtain a detail of the liver that had never before seemed possible, but in addition we succeeded in accurately outlining the spleen with its pedicle, both kidneys, and under special technique we obtained shadows of the uterine appendages. In one case we were able to detect a chain of enlarged mesenteric glands. Intraperitoneal adhesions, especially involving the anterior abdominal wall, were easily shown. It was thus demonstrated that this method opened up an entirely new field for investigation, particularly of the parenchymatous abdominal organs.

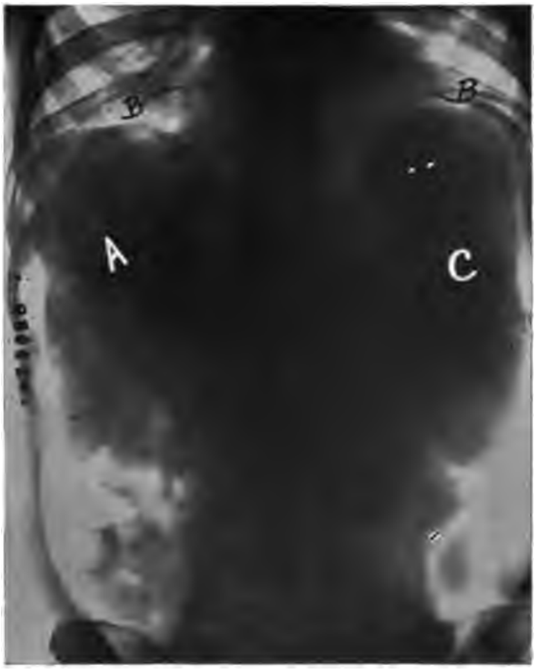

FIG. 10. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Enlarged syphilitic liver; *B*. Diaphragms; *C*. Enlarged syphilitic spleen.

The technique required for the inflation is extremely simple. After the intestinal tract has been thoroughly cleansed and the bladder emptied, the patient is put upon his back. As a rule a point is selected on the anterior abdominal wall about 1 inch to the right or left and 2 inches below the umbilicus. The skin is thoroughly scrubbed and sterilized with tincture of iodine. If adhesions are known to be present or an abdominal scar is visible, it is well to avoid this area. After the skin has been anesthetized with an ethyl cloride spray, an ordinary lumbar puncture needle is passed obliquely downward until it reaches the fascia; the needle is then pushed gently through the fascia muscle and peritoneum into the abdominal cavity. The plug is withdrawn and the needle connected with a rubber tube,

FIG. 11. POSITION NO. 2. POSITION OF THE PATIENT AND APPARATUS TO OBTAIN BEST DETAIL OF KIDNEY. Patient lying on left side for right kidney and lateral liver; on right side for left kidney and lateral spleen.

the other end of this tube having been previously attached to the outlet of an ordinary oxygen tank. Oxygen is now allowed to flow gently into the peritoneal cavity. Sufficient gas should be used to render the abdomen dome-shaped in appearance; as a rule it requires about four liters, the quantity depending largely on the amount of relaxation to the abdominal walls. In case the pressure from the tank should be too high, the rubber tube will jump off the needle, as the caliber of the needle is very small.

The tube is then disconnected, the needle quickly withdrawn, and the site of

the puncture covered with a small piece of adhesive plaster, the entire procedure having been conducted under modern aseptic precautions.

The patient frequently complains of a sense of fullness from the distention, and may have some pain in the shoulders, especially the right, probably caused by pressure on the diaphragm. This pain varies in intensity, usually gradually disappearing within a few hours. Only three cases in our series have required an opiate.

The roentgen examination should be made as soon as possible after the inflation. It is well, however, to allow the patient to become accustomed to the distention before proceeding. As a rule about an hour is sufficient. If a longer interval is allowed emphysema is liable to occur from leakage of oxygen through the peritoneal opening into the outlying structures. Such an event interferes with obtaining clear detail of the abdominal organs.

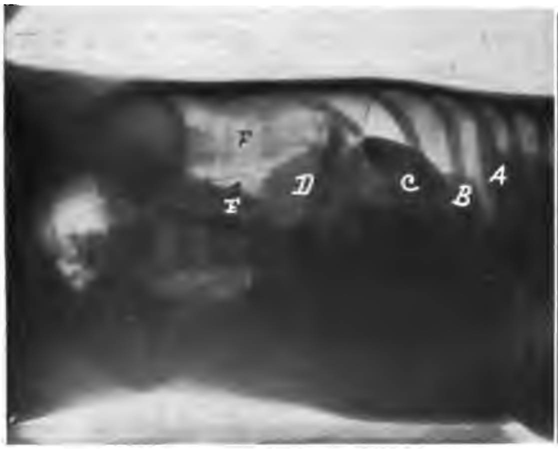

FIG. 12. OBTAINED WITH PATIENT IN POSITION NO. 2. *A*. Left diaphragm; *B*. Left lobe liver; *C*. Spleen; *D*. Left kidney; *E*. Inferior mesenteric artery; *F*. Descending colon.

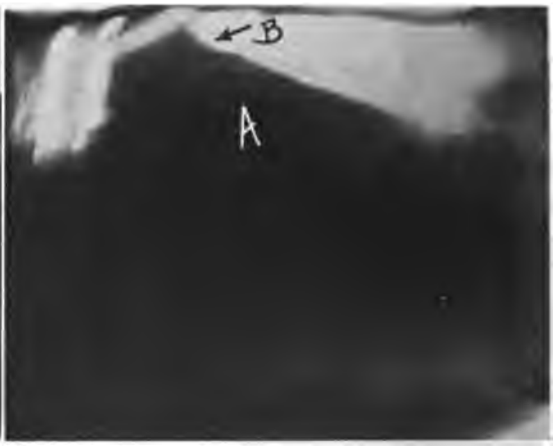

FIG. 14. OBTAINED WITH PATIENT IN POSITION NO. 2. *A*. Liver; *B*. Gumma of liver.

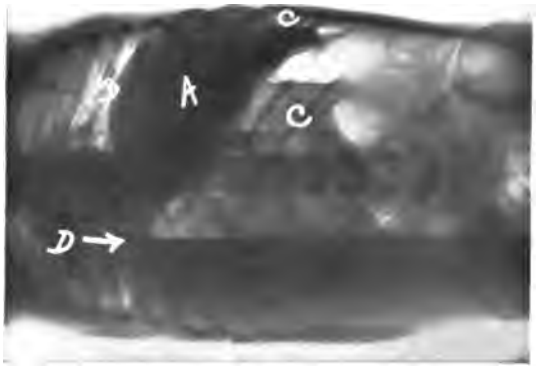

FIG. 13. OBTAINED WITH THE PATIENT IN POSITION NO. 2. TUBERCULAR PERITONITIS. *A*. Liver; *B*. Right diaphragm; *C*. Adhesions; *D*. Fluid level—Ascites.

Up to the present time we have not attempted sterilizing, filtrating or washing the oxygen, feeling that the more complicated the apparatus the more liable we are to infection.

The oxygen is gradually absorbed by the abdominal tissues, disappearing almost completely in from 24 to 48 hours.

The roentgen technique is not complicated. Satisfactory fluoroscopic observations can be made in the prone; more reliance is placed on the roentgenographic studies, however, as the patient must be placed in positions which are difficult to duplicate under the screen. The cardinal point to be constantly borne in mind in making the roentgenographic examination is that the particular organ which is to be investigated must be placed in the highest plane possible in order that it may be completely surrounded by the gas, and

that the intestines, which are freely movable in the presence of oxygen, be allowed to drop away, thus avoiding conflicting shadows. This particularly applies to the kidneys and uterine appendages.

To obtain the best detail of the diaphragm and liver with the gall-bladder region, the spleen and the glandular enlargements, the patient lies on the abdomen with the tube above, and stereoscopic roentgenograms are made from behind forward.

Further liver and spleen details with excellent kidney outline are obtained by having the patient lie on the side. If the left kidney and spleen are being investigated, the patient lies on the right side, the left being uppermost, the tube is placed in front and the plate properly supported with sand bags behind. If detail of the liver and right kidney are sought, the patient lies on the left side, other requirements being the same.

FIG. 15. POSITION NO. 3. Position of the patient and apparatus to obtain detail for lateral pelvis and kidneys.

FIG. 17. POSITION NO. 4. Best position of patient and apparatus to obtain detail of the pelvic organs.

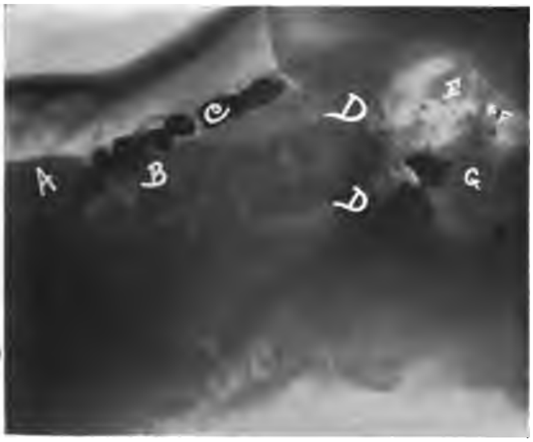

FIG. 16. OBTAINED WITH PATIENT IN POSITION NO. 3. *A*. Spleen; *B*. Left kidney; *C*. Descending colon; *D*. Pelvic colon; *E*. Left ovary; *F*. Left tube; *G*. Fundus uteri.

There are two positions for obtaining satisfactory shadows of the uterus and appendages: the right and left exaggerated lateral Trendelenburg, obtained by placing the patient on the side and elevating the hips on a support about 6 inches high with the thighs and legs slightly flexed and the shoulders and head low, resting on the table; the tube and plate in similar relation to the patient as in the straight lateral. The other position, which seems to bring out the best detail of the pelvic organs, is obtained by the use of a canvas top table, one end of which has been elevated about 15 degrees. The patient lies on the abdomen, the head towards the most dependent portion of the table, the plate is placed on the back, properly held in position by sand bags, the tube is beneath, the anode being centered on the promontory of the sacrum. By this method the intestines drop out of the pelvis and are

Fig. 18. Obtained with Patient in Position No. 4. *A*. Fundus uteri; *B*. Right tube; *C*. Right ovary; *D*. Left tube drawn over by adhesions; *E*. Left ovary.

Fig. 19. Position No. 5. Position of patient and apparatus to obtain best detail of intra-abdominal adhesions especially if they involve the anterior abdominal wall.

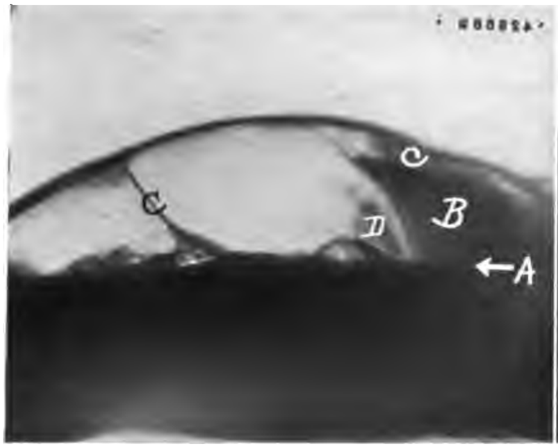

Fig. 20. Obtained with the Patient in Position No. 5. Tubercular Peritonitis. *A*. Fluid level—Ascites; *B*. Liver; *C*. Adhesions; *D*. Right kidney.

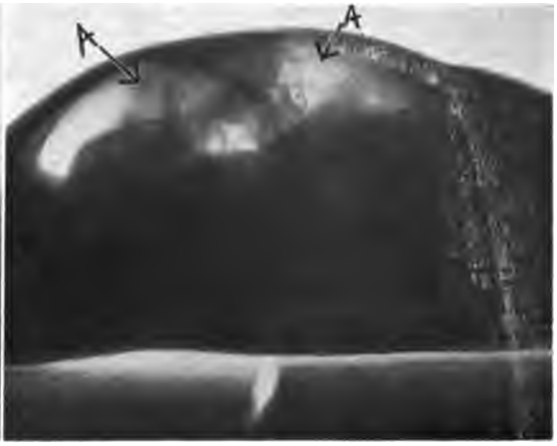

Fig. 21. Obtained with the Patient in Position No. 5. Tubercular Peritonitis. *A*. Adhesions.

replaced by the oxygen, which surrounds the fixed organs.

Intraperitoneal adhesions are detected by placing the patient on the back, the plate on one side and the tube on the other.

No doubt as the work advances other positions will be developed giving more information than those described. The field seems unlimited. Plates in envelopes are used, as giving the best detail.

The two factors that must be considered in the use of this method are the danger of infection and the risk of puncturing the intestines. The first can be overcome by the ordinary precautions; regarding the second objection we feel that with care there is absolutely no danger of puncturing the intestine. In our series of 37 cases we have never experienced the least difficulty. It has been demonstrated that with a needle passed through the abdominal

wall into the peritoneal cavity of a live rabbit, the intestines would always recede before the sharp point, and the moment the rabbit died puncture would occur. This characteristic of the involuntary muscle fiber is also practically shown by the large number of sharp foreign bodies which pass through the intestinal tract without puncture. We have never known of a puncture of the intestines occurring in a paracentesis of the peritoneal cavity when ordinary precautions were observed.

In conclusion we should like to state that from our present experience this procedure is not a competitor of the opaque meal method, as the latter concerns the hollow organs, while oxygen inflation of the peritoneal cavity gives us information more particularly as to the solid structures of the abdominal cavity. In conjunction, the results should be ideal.

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DISCUSSION

DR. CHARLES A. WATERS.—I should like to ask Dr. Stewart if he has had any experience in injecting the lesser peritoneal cavity, and if he has had any cases of tumor such as retroperitoneal sarcomata which are confused with hypernephromata.

DR. W. H. MANGES.—Dr. Stewart was kind enough to come to Philadelphia recently and show some of these slides and try to encourage us to do some of the work. Shortly after his visit a lady was sent to me from Delaware with the request that I examine her liver by the x-ray. That was all I had to go on. She was a large woman, and in addition to that her abdomen was enormously distended with fluid. Her tissues were mostly all edematous, and the heart shadow also was very greatly enlarged, although it had a practically normal heart-shaped outline. I realized at once the futility of making any effort to study the liver of such a patient. Her two daughters were with her and I tried to explain to them that it was a physical impossibility to get any information in regard to her liver in her present condition. I told them, however, that it seemed to be indicated at least that some of the fluid that she carried should be removed if for no other reason than to give her some relief. Now this lady had traveled on the train and by taxicab and walked into the hospital and was very much fatigued. She was persuaded to stay in the hospital a few days for study. To make a long story short, we tapped the abdomen and removed a large bucket-full of fluid and merely hitched an oxygen tank on to the same needle and inflated the abdomen so that it was in the same condition, as to tension, as it was before. We allowed the patient to stay in bed for about an hour and then brought her to the x-ray room. She got up and walked about the x-ray room with as much comfort as she had before. We examined her standing and lying and on her side, in every position, and it did not make any difference to her. Now that patient was in a pretty sick condition, so that I think that patients that can walk around, can walk just as well with the abdomen inflated as before.

The interesting point in this case was that the parenchymatous organs were perfectly normal in shape and outline, so that it was not

a case of cirrhosis of the liver nor a case of lesion of the kidney. That, taken together with the general picture of anasarca, showed that she did have a picture of myxedema and she improved under treatment for that condition.

Dr. A. H. Pirie.—I would like to ask Dr. Stewart if he has examined these patients standing up, and whether it is a safe procedure, and whether the organs falling down cause pain.

Dr. William B. Bowman.—In acute subdiaphragmatic conditions, such as a subdiaphragmatic abscess, is there not a certain amount of danger of the oxygen breaking up some newly formed adhesions with the resulting change of a local infection into a general one?

Dr. William H. Stewart.—This work is new. So far as we can ascertain it has never been done in this country before. There are, of course, many problems to solve, some of which I am not able to answer at the present time. We started the investigations in June. So far thirty-eight cases have been inflated and examined roentgenographically. The method must be adopted in all obscure abdominal lesions. You will meet with difficulties in obtaining support, but keep at it as we propose to do. All new and valuable methods meet with very little encouragement at first, even the bismuth meal received a cold reception when first advocated.

So far we have not been able to differentiate between the lesser and greater peritoneal cavity after inflation.

It should be of greatest value in the differentiation between hypernephroma and splenic enlargement.

In answer to Doctor Pirie, we would say that early in our investigations we examined the cases in the erect position, but they did not seem to take kindly to this position. After one patient had broken a Coolidge tube by using the tube-stand as a support, we discontinued. It was also found that most of the cases gave all the necessary information in the prone.

We were indeed pleased to have the support of Doctor Manges. It has been noted that cases which have had peritoneal effusions seem very tolerant to the inflation. This may explain why his patient was able to walk around with so little discomfort. We hesitate to endorse this procedure, however, believing that most of the cases should remain in the prone position while the distention is greatest.

It is possible that the oxygen might break up some newly formed adhesions. I feel, however, that one must take some chances in all methods of diagnosis. I am quite satisfied if I can clear up some obscure condition so that the patient is saved from an exploratory operation.

NON-TRAUMATIC EPIPHYSEAL SEPARATIONS

BY WILLIAM A. EVANS, M.D.

DETROIT, MICH.

THE frequency with which we have encountered both recent and old epiphyseal separations of the hip joint without a history of trauma leads us to make a more or less exhaustive study of the literature pertaining to epiphyseal separations and juxta-epiphyseal fractures.

Our interest in the subject was accentuated by a reversal of our diagnosis of spontaneous epiphyseal separation by one of the most prominent Eastern orthopedists. Without any hesitation whatever he declared that the condition was one of a fracture of the neck of the femur, and that the case had been maltreated.

All of the cases observed showing active symptoms were in patients of the adolescent period. Invariably these patients were of overweight and were oversized for their age. Of nine cases which came under observation, two occurred in girls and seven in boys.

The following case report is typical of all the cases, with the possible exception that the symptoms persisted over a longer period of time, and the permanent deformity was not as great as is most frequently observed:

CASE I, PLATE 1. June 19, 1917. The plate shows a slight decalcification of the osseous structures, and a little disturbance of the epiphyseal line. This is best shown at the lower margin.

CASE I, PLATE 2. Oct. 6, 1917. Same finding as plate I with a little more disturbance at the lower margin.

Miss S., age eleven and a half years, with a development of thirteen or fourteen years, was referred for roentgen examination of the hip in June, 1917. The history was that of lameness, apparently the result of some pathology in the hip-joint. The previous history indicated some symptoms in the knees, with the left showing the more pronounced symptoms, the symptomatology being confined to pain and a resulting limp. Nothing was revealed on physical examination, either locally or constitution-

ally. The plates which were obtained at this time showed a slight demineralization of the left pelvis in the immediate vicinity of the acetabulum, especially opposite the upper quadrant of the head of the femur. Special attention was paid to the epiphyses, the statement being made that there was a symmetrical appearance of the epiphyses both for the heads of the femora and of the greater and less trochanters. No attempt was made in the report to explain the slight bone change, it being stated that the same findings frequently suggested an early infection. After a period of rest, the symptoms subsided and the patient was able to spend the summer in a camp where she indulged in all the strenuous exercises incident to camp life, and not until she returned to the city in September was there the term "Non-Traumatic Epiphyseal Separation" of the head of the femur, a condition which we previously had held to be associated with adolescent rickets. It was following this examination, that the patient was taken East and had the case diagnosed as a fracture at the neck of the femur.

The literature is entirely concerned with the question of epiphyseal separations and juxta-epiphyseal fractures, and the etiological factor of trauma is always admitted.

One orthopedic school maintained that practically every case of epiphyseal separation of the upper end of the femur was really one of fracture. This is the view of Whitman, and he wrote freely on the subject; and no doubt many men in the East still hold the views which he presented.

CASE I, PLATE 3. March 29, 1918. Plate shows a wide epiphyseal separation with disappearance of the epiphyseal line.

CASE I, PLATE 4. May 7, 1918. End-result. Note condition of the coxa vera.

any development of the former trouble. A second examination was made in October, 1917, and at this time there was noted the same mild osteoporosis of the structures about the left hip, but in addition there was reported a disturbance in the epiphyseal line at the head of the left femur. In offering a diagnosis at this time, we suggested

On the other hand, Hoffan and Sprengel maintained that a fracture of the neck of the femur in childhood was rare, and that the usual injury consisted of an epiphyseal separation. We believe that this view has been borne out by the later experiences of many men, and this is the view which the writer has come to hold after a review of

our own cases; that is, that epiphyseal separations are much more common in children than fractures of the neck of the femur. However, we are not especially interested at this time as to the relative frequency of epiphyseal separations and fractures of the neck of the femur of traumatic origin in children.

We wish to limit ourselves to the type of cases in which as far as can be determined, trauma is not the etiological factor in the pathology. The etiological factor in epiphyseal separations has not been determined; but we are of the belief that it is the manifestation of some general condition, probably associated with disturbed internal secretion. As previously stated, all of the active cases occurred at the age of puberty and there was evidence of abnormal internal secretion, since the patients were all of the feminine type and showed excessive development.

CASE VII, PLATE 5. Jan. 2, 1919. Plate shows an extreme epiphyseal separation with demineralization of femoral head.

CASE VII, PLATE 6. June 4, 1919. Result after appropriate manipulation and fixation.

It was suggested that lues was the etiological factor, but this was ruled out by the usual tests for this condition.

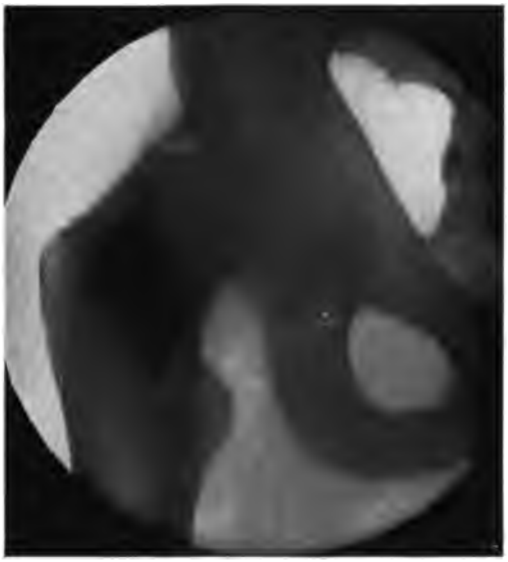
The fact that all our separations involve the hip joint only would offer no objection to the explanation for the condition, because the relations of the diaphysis and epiphysis at the head of the femur are peculiarly favorable to slipping, providing that there is a disturbance in the weight of the patient and strength of the parts.

The diagnosis of the condition is based, then, upon the history of pain in the hip joint and, in some cases, pain referred to the knee. The onset may be rapid or gradual, and the progress of the case may be acute, or in other cases interrupted by periods when no symptoms whatever present themselves. These symptoms, then, are at variance with those described in Robert and Kelly's treatise on fractures and in Tubbey's Disease of Bones and Joints, and in these works the only etiological factor given is that of trauma.

Stereoscopic plates made of the affected hip show a general loss of the lime salts, and more particularly a disturbance in the epiphyseal line, with slipping. The deformity is best shown by extreme external rotation of the thigh when the plates are made.

The severity of the symptoms and the extent of the deformity depend entirely, of course, upon the degree of separation. As

in the case report given in detail, we believe that there is a degree of separation which is productive of symptoms but which cannot be demonstrated by the ordinary roentgen plate, and, too, the degree of separation may be so slight that while it can be demonstrated upon the plate, there is no deformity evident upon physical examination. The cases of extreme or complete separations offer no difficulty in diagnosis. inasmuch as there is present a shortening and rotation of the limb, and limitation of movements of the affected joint.



Case III, Plate 7. Result of epiphyseal separation and non-treatment.

From the roentgen examination alone, we cannot distinguish between the epiphyseal separation which accompanies a general condition and the separation which results directly from a trauma. Furthermore, we have noted that the condition is a progressive one, even in the case of the traumatic type of separation. It is this point which probably leads its supporters to the view that all separations result from trauma, they claiming that the original trauma may be overlooked. Of course the development of the two conditions is so distinct that there is no question in our minds that the type appearing during the period of adolescence is a distinct type. The writer is of the opinion that this condition should not be confused with Perthey's disease, which was fully described in an article by Dr. Frederick C. Kidner, of Detroit.

The prognosis in the condition depends, then, in the first place, entirely upon an early diagnosis, and upon the treatment adopted following the demonstration of an

Case IX, Plate 8. End result. Non-recognized and non-treated epiphyseal separation.

epiphyseal separation. In slight separations a good result will be obtained if the part is put up in a plaster cast with strong flexion and external rotation of the thigh. The period of fixation should extend over four or six months. In the cases of extreme separation, when the deformity has existed only a relatively brief time, a great improvement in the relations of the diaphysis and epiphysis can be obtained by proper manipulation. See Case VII, Plates 5 and 6.

COCCIDIOIDAL GRANULOMA *

BY WILLIAM B. BOWMAN, M.D.

LOS ANGELES, CALIF.

COCCIDIOIDAL GRANULOMA is a definite, acute, subacute or chronic disease due to an infection by a parasitic organism or mould-like growth called by Ophüls the Oidium Coccidioides. It is sometimes called the California disease owing to the fact that all of the cases reported, with but three exceptions, have either lived in or visited that State before contracting the disease. Not only have most of the cases lived there, but a large percentage of them have come from one district of the State, viz., the San Joaquin Valley.

Whether this disease is peculiar to California or not, no one at the present time can definitely state; personally, I am of the opinion that it is probably prevalent throughout the country, but owing to the fact that most of the profession are unaware of the existence of such a disease it still remains unrecognized; this statement being based on the fact that even the pathologist, if he is not on the lookout for it, is very prone to diagnose this disease as some form of tuberculosis.

The first case was reported in 1894 by Rixford of San Francisco, and later in detail by Rixford and Gilchrist, who at that time stated that the disease was due to a protozoa and called it pseudo- or coccidioidal tuberculosis. In 1892, Wernicke, and later Posadas, reported a case in Buenos Ayres, which in all probability was coccidioidal granuloma. In 1905, Ophüls reported twelve cases, and suggested the name coccidioidal granuloma, and proved beyond a shadow of a doubt that it was caused, not by a protozoa, but by a parasitic fungus or mould-like growth which he called the Oidium Coccidioides. In 1914, MacNeal and Taylor, in a résumé of the literature, stated that twenty-four definite cases had been reported up to that time. Dickson, in 1915, gives a detailed article stating that forty cases had been reported, thirty-five of the patients had been residents of California, three had visited the State, and twenty-seven had been residents of San Joaquin Valley in that State.

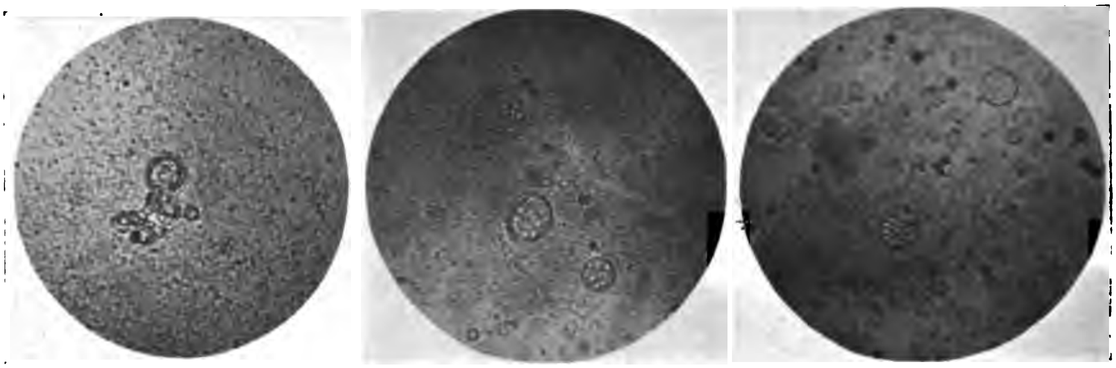
The oidium coccidioides occurs as a spherical body varying in size from seven to thirty microns in diameter. It consists of an irregular protoplasmic body with a double contoured, highly refractile surrounding membrane or capsule, and they multiply by sporulation. The fungus grows on all types of media. The mode of infection in the human is unknown. The pathology so far described, both grossly and histologically, especially in the viscera, has been practically identical with that of tuberculosis and a differential diagnosis could only be made by the isolation of the organism.

Rixford states that in bone conditions there is extensive destruction with formation of tubercle-like nodules and with large giant cell formations of the Langhans' type, and that it resembles both macro- and microscopically genuine tuberculosis. Hammock, pathologist at the Los Angeles County Hospital, states, however, that in bone and joint conditions it was noted both macro- and microscopically that the process seemed somewhat more acute than in tuberculosis. He also states that in three cases he noticed the tendency of the suppurative process to extend along the tendons and muscle sheaths to a considerable distance from the joint. The literature makes practically no reference to the roentgen findings in these cases.

A positive diagnosis can be made only upon the finding of the organism in the pus or tissues. This can easily be done by mixing a drop of pus with a drop of 10

* Read before the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3-6, 1919.

per cent sodium hydrate on a slide with a cover slip. After a few minutes, when the pus cells have been destroyed, the parasites, which are much more resistant, are easily found. Dickson states in his article that a routine examination of cases clinically tuberculous, in which the tubercle bacillus cannot be found, would probably



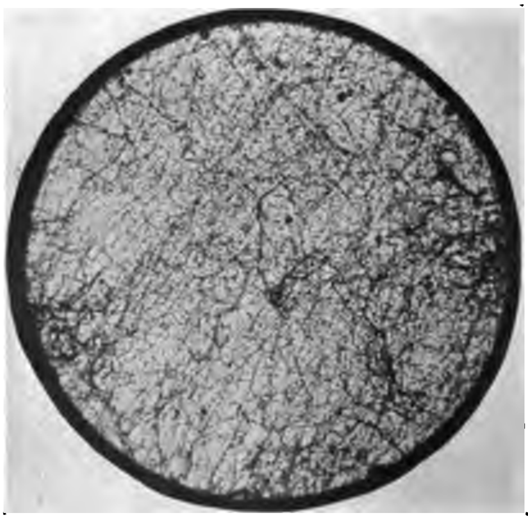
* FIGS. 1, 2, 3. SHOWING THE OIDIUM COCCIDIOIDES IN VARIOUS SPORULATING STAGES.

reveal a great many cases of coccidioidal granuloma.

Through the kindness of Dr. J. Mark Lacey, Assistant Medical Director of the Los Angeles County Hospital, who has kindly given his permission, I now wish to present the case histories together with the roentgen findings of five patients afflicted with this disease, coming under our observation during my service as attending roentgenologist at that Hospital. In all of these cases, the positive diagnosis was made by the pathologist.

CASE I. Patient 90968 G. O., Mexican ranch hand. Entered the Los Angeles County Hospital Feb. 4, 1916, with an admitting room diagnosis of monarticular rheumatism and sent to the medical service. Complaint was that of pain and swelling of the left ankle; the pain had existed one month prior to entrance to the hospital, the swelling appeared a little later. The pain had come insidiously, and was aggravated by walking and exercise. This was not accompanied by a rise of temperature nor associated with a sore throat or tonsillitis.

Past history as to disease was negative except for an attack of gonorrhea in 1913. Denied chancre, and blood Wassermann was negative. Patient was born in Southern Mexico in 1891 (twenty-five years of age), and worked in different parts of Southern Mexico until 1910. He then came to Bakersfield, Cal., where he worked as track-hand on the railroad for a short time, then came to Los Angeles, and since that time has spent two, three or four months each year at Oxnard, Ventura County,



* FIG. 4. SHOWING THE MICROSCOPIC APPEARANCE OF THE GROWTH AS IT APPEARS ON ARTIFICIAL CULTURE MEDIA.

* Plates furnished by Dr. Charles W. Bonynge, Bacteriologist, Los Angeles, Calif.

helping with the bean crop, mostly as a threshing hand.

His general condition became rapidly worse, his temperature being elevated to 101.2° in the afternoons with a morning temperature usually around 99° and 100°. Pulse rate increased from 90 to 120 before operation, performed by Dr. R. on Feb. 15, 1916, when a curettage of the bone of the ankle joint was done. Nothing was re-

FIG. 5. CASE I. (PATIENT 90968). RIGHT ANKLE SHOWING INVOLVEMENT OF THE INTERNAL MALLEOLUS AND INTERNAL TWO-THIRDS OF ARTICULAR SURFACE OF THE TIBIA.

moved but bloody granular tissue, the joint being drained with a through and through drain. Microscopic examination of the curettings on section showed chronic inflammation with giant cell infiltration. Culture showed staphylococcus growth, and a diagnosis was then made of tuberculosis of the joint with secondary infection.

Patient's condition grew steadily worse, the right ankle becoming involved a short time later, and on March 21, 1916, Dr. R. again operated, doing a curettement of both the right and left ankle joints, removing necrosed bone and pus. Patient's general condition rapidly became worse. Microscopic findings from the results of the second operation were chronic granulation with endospore cells found resembling coccidioidal granuloma, giant cells being present in goodly number; and a diagnosis of coccidioidal granuloma was made.

Guinea pig inoculated intraperitoneally with pus developed typical lesions of coccidioidal granuloma.

Blood count at this time showed 8,500 leucocytes with a differential of 14 small mononuclear lymphocytes, 3 large mononuclear lymphocytes, 1 transitional and 81 polymorphonuclears.

Roentgen Findings.—Right ankle: small irregular areas of necrosis involving inner two-thirds of articular surface of tibia. Slightly irregular, fuzzy thickening of the periosteum of internal malleolus.

Patient died from the infection April, 1916.

AUTOPSY. 90968. Body greatly emaciated. Pus was present in the sinuses leading to the ankle joints and extended upward in the legs for a few centimeters along the tendons. Articular surfaces were roughened, and the bone immediately adjacent to the joint somewhat softened.

Lungs.—Scattered through the left lung were numerous small semi-gray nodules resembling tubercules. There were a few larger nodules with caseous centers. Similar nodules were seen in the upper and middle lobes of the right lung. All of the lower lobe except the anterior margin was firm and airless. The cut surface was smooth, gray, comparatively dry and had a gelatinous appearance similar to a gelatinous tuberculous pneumonia.

Esophagus.—In the esophagus on the anterior wall adjacent to a mass of enlarged peribronchial lymph-nodes was a deep irregular ulcer, and imbedded in its base was found an oat kernel in its hull. The lymph-nodes were adherent to the esophagus and the one immediately beneath and practically forming the base of the ulcer contained pus. Other peribronchial nodes were enlarged and firm; some contained necrotic areas.

Heart.—The pericardial cavity was al-

most entirely obliterated, and binding the parietal pericardium to the heart was a friable grayish granulation tissue. The heart muscle was brown, rather flabby. Valves thin and pliable; twice the normal size. Cut surface reddish brown. No focal lesions. *Gall-bladder* apparently normal. *Stomach* apparently normal.

Intestine.—Scattered through the lower portion of the small intestine were numerous ulcers, the largest about 2 cm. in diameter. These had elevated rather firm edges and irregular bases. Opposite the ulcers could be seen small gray nodules resembling tubercles. *Adrenals* apparently normal. *Spleen*, normal size, soft, no focal lesions.

Kidneys.—Negative except for slight cloudiness of cortex. *Bladder* and *prostate* apparently normal.

Microscopic examination of the lesions revealed changes similar to those caused by the tubercle bacillus, except that there was less tendency to fibrosis, and polymorphonuclear leucocytes were more numerous than in most tuberculous lesions. Parasites were found in the ulcer of the esophagus, in the pneumonic lung, in the discrete nodules of the lung, and in the pericardium, being especially numerous in the latter.

CASE II. Patient 105911 D. B., eighty-three years of age, Negro, male, entered the hospital March 31, 1917, with an admitting room diagnosis of infected ankle joint, and was sent direct to the surgical service.

The complaint consisted of pain and a moderate amount of swelling in the left ankle joint. It had been opened somewhere before entering the hospital. The onset was supposed to have been acute, beginning about two months before, but not accompanied with any systemic disturbances or elevation of temperature except for a rise to 99.2° in the afternoon with a pulse ranging from 80 to 114.

Past history, negative; denies disease of all kinds; blood Wassermann negative. Has worked about horses all his life, the past twelve years having been spent in Los Angeles as coachman, and later as handy man about the home of a physician in that city.

On April 10th, ten days after admission, the left ankle joint was curetted, necrotic bone and pus being removed. Microscopic examination of the pus showed many spherical refractile bodies 15 to 30 microns in diameter with double contoured walls and granular cytoplasm. Some of the

FIG. 6. CASE II. (PATIENT 105911). LEFT ANKLE. Note beginning destruction of articular surface of tibia with small area of involvement on posterior surface of bone.

larger ones were filled with very numerous spherical bodies which are endospores. From cultures there grew on several occasions, a fungus with white fluffy cotton surface, turning brown after a few days at the edges and next to the agar. Smears from cultures showed only mycelium.

On May 1, 1917, the left leg was amputated by Dr. C., at the middle one third. This wound healed very slowly; the general condition was good and the patient left the hospital on June 4th, in fairly good condition, there being only a scanty discharge of sero-sanguinous material. Subsequent reports from time to time have been to the effect that the wound has remained practically healed all the time,

although at times there has been a slight semi-purulent discharge.

A guinea pig inoculated intraperitoneally with pus from the lesion died after five weeks. Autopsy showed numerous tubercle-like nodules in lungs and spleen, a few in the liver and a suppurative orchitis. Numerous typical spherical organisms were found in these lesions.

Roentgen Findings.—Left ankle: Articular surface of the tibia slightly irregular, hazy, and showed beginning destruction of the articular surface of the joint. Small area of rarefaction on posterior surface of tibia. Finding typical of a tuberculous joint.

FIG. 7. CASE III. (PATIENT 107525). LEFT WRIST SHOWING MARKED INVOLVEMENT OF ARTICULAR SURFACE AND LOWER END OF RADIUS. Note the displacement and early involvement of the semilunar.

CASE III. Patient 107525 B. B. Male, Mexican, fifty-four. Entered the Los Angeles County Hospital, May 20, 1917, with a diagnosis of right psoas abscess and an infected left hand. Complaint consisted of pain and pus discharge from the left wrist, the wrist having become swollen at some time previous and incised, from which wounds there persisted a most purulent discharge. Pain and swelling in the right lower quadrant, on physical examination proved to be a solid tumor of about the size of the patient's two fists.

Past history as to diseases was negative, denied syphilis, and blood Wassermann gave a negative result. He has worked in and about Los Angeles County as a ranch hand, having the care of horses, for the past ten years.

Smears taken from the pus of the wrist show many spherical bodies 20 to 50 microns in diameter, with doubly contoured membrane. Many show division of protoplasm into many spheres (endosporulation). Cultures show much bacterial growth, though after five days the typical growth of coccidioidal imitis appeared.

Patient was taken from the hospital June 20th, seven days after admittance, and from subsequent information we learned that a fatal termination was reached a few days later, no autopsy having been performed.

Roentgen Findings.—Left wrist: Marked destruction of articular surface of radius, the bone having a punched out appearance such as seen in some cases of joint tuberculosis. Outer border of radius shows a roughened, irregular, fuzzy thickening of the periosteum. Apparent dislocation of semilunar and scaphoid. The semilunar shows beginning involvement.

CASE IV. Patient 109024 T. B. Male, Mexican laborer, twenty-eight. Ranch hand, living in Los Angeles County for past eight years in vicinity of East Lake Park. Entered hospital June 22, 1917.

In September, 1916, went to Merced County, San Joaquin Valley, and worked on ranch, returning December, 1916. In October, 1916, developed "malaria" which resisted treatment until early in January, 1917, when left index finger began to swell and became very painful, though he attributed this to an injury. Later, a subcutaneous nodule appeared on scalp and another over the left zygoma, other fingers began the same way as the first, and pain appeared in the knees and left wrist.

All infected fingers were then amputated, right patella was removed, and left knee and wrist opened and drained; later left leg was removed at level of upper and middle one-third of thigh.

Most of the wounds healed very slowly, and on September 21st patient left hospital, still having discharging sinuses of left wrist and right knee and stump of left thigh.

Jan. 30, 1918, patient still alive. Has been up and about in wheel chair. Arm very badly involved, all lesions extensively broken down and exuding characteristic pus. Immense cauliflower granulations are seen in each lesion. Attending surgeon states that he may advise patient to return here for amputation of this extremity.

Roentgen Findings.—Chest and spine negative. Left hand: All carpal and proximal, one-third of second, third, fourth and fifth metacarpal bones poorly defined. There is marked destruction of these bones, including the articular surface of radius and ulna, considerable increase in transparency, and blurring of the outline of same and thickening of the surrounding soft tissues. A typical picture of tuberculosis of the wrist and hand.

Right knee: Patella has already been removed. Articular surface of both bones and particularly of the femur is hazy, irregular, with diminished density and blurring of anterior surface of lower end of femur. Soft tissues show considerable increase in density.

Fig. 8. Case IV. (Patient 109024). Left Wrist and Hand Showing Coccidioidal Involvement of Lower End of Radius, Ulna, All Carpal and Second, Third, Fourth and Fifth Metacarpal Bones.

Fig. 9. Case IV. (Patient 109024). Right Knee. Note absence of patella. Shows involvement of articular surface of both the femur and tibia with considerable increase in density of soft tissues.

Case V. Patient 111871 E. L. Male, Mexican laborer, forty-eight. Entered Los Angeles County Hospital September 17, 1917; diagnosis, ulcer of foot.

Eight months before entering hospital patient lived in Calexico, Imperial Valley, working in cotton fields. Had lived in Los Angeles four years previously, and in San Joaquin Valley eighteen years ago for a period of six months. Had worked very little with animals, but always on ranches with hay and grain. Eight months ago injured right ankle, and swelling and pain have existed ever since. He claims that a physician treated the sprain three months ago and immediately afterwards a sinus formed, since which time several other

sinuses have developed discharging thin purulent material. Ankle very painful and swollen.

Past history negative. Blood Wassermann negative. Fresh smears showed the organisms of coccidioidal granuloma; culture showed abundant growth after seven days' incubation, and guinea pig inoculation intraperitoneally showed characteristic lesions in all viscera and especially the genitalia. Patient showed no elevation of temperature while in the hospital and was otherwise in best of health. When amputation was suggested he left the hospital, refusing to give a future address.

Roentgen Findings.—Right ankle: Small circumscribed area of rarefaction in lower end of fibula. Tip denuded of periosteum with some bone destruction. Internal malleolus shows marked bone destruction with considerable irregularity and fuzzy thickening of the periosteum. Not a typical tuberculous ankle. Advised Wassermann, although hardly enough proliferation present for a syphilitic joint. Roentgen diagnosis reserved.

At the time of examination the clinical diagnosis was tuberculosis, and while the clinical and roentgenological department were trying to agree on a diagnosis, the pathological department isolated the organism of coccidioidal granuloma.

I am also indebted to Doctors Ruggles and Bryan of San Francisco for the privilege of presenting one of their case reports and lantern slides of a case of coccidioidal granuloma of the lung.

CASE VI. W. H. Male, age fifty-four, single. Occupation, farmer. Patient entered University of California hospital, May 11, 1918, with complaint of "multiple abscesses."

Family history unimportant. Past history negative, except that he lives in Visalia and comes in contact with horses and cattle.

Present complaint: Patient dates beginning of trouble to September, 1917, when he suddenly developed headache, temperature of 105° and a cough accompanied by substernal pain. Two weeks later numerous small pustules developed over entire body, progressing slowly and ter-

FIG. 10. CASE V. (PATIENT 111871). RIGHT ANKLE. Lateral view.

FIG. 11. CASE V. (PATIENT 111871). RIGHT ANKLE. Note the peculiar, irregular, fuzzy appearance of periosteum on internal malleolus.

minating in spontaneous rupture or surgical drainage, followed by persistent sinuses. Cough subsided for a few weeks, but reappeared, and has persisted since that

FIG. 12. CASE VI. Note coccidioidal involvement of the upper left lobe. Autopsy showed changes in the right lung to be due to malignancy.

time. Slight hemoptysis on various occasions. Patient had lost 65 pounds in nine months.

Examination of body showed numerous chronic pustular lesions in varying stages from suppuration to healing. Cultures of both the pus and sputum showed oidium coccidioides. Wassermann, negative.

Therapy.—Sodium iodides, no results. Tartar emetic, no results. Copper sulphate, both internally and locally, no results. Autogenous vaccines, no results.

Roentgen Findings.—Pulmonary tuberculosis.

Patient died November 30, 1918.

Autopsy Findings.—Left lung coccidioidal granuloma. Primary carcinoma of the central portion of the right lung.

The roentgen findings in all these cases to my mind greatly resembled those of tuberculosis, the peculiar irregular, fuzzy appearance of the periosteum, being the only distinguishing feature.

It may be well to bear in mind in the future when dealing with suspected tuberculosis of bones or joints that possibly it may be a case of coccidioidal granuloma, and I trust that further investigation will assist materially in aiding us to make a definite positive roentgen diagnosis of this disease.

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DISCUSSION

DR. M. P. BURNHAM.—Dr. Bowman's paper is the first roentgen presentation of this rare and usually fatal disease. I will add four brief case reports and show slides of two. Case I represents an unusual instance of early diagnosis made by aspiration of a joint and followed by immediate amputation of the shoulder, based on the findings, and the man has remained apparently well.

This case is one of the cases of all reported to date that did not terminate fatally and would tend to show that if diagnosis is made early and radical surgery instituted a larger percentage of recoveries might be expected.

DR. HOLLIS E. POTTER.—Dr. Bowman asked me to say a word about the lesions in this disease as compared with those of blastomycosis seen and described in Chicago. Eight or ten years ago there was considerable discussion on this point between pathologists and clinicians. About that time I published in our journal seven cases of bone lesions in systemic blastomycosis, which brought out the following *x*-ray findings for blastomycosis: (1) In the short bones the findings were those of simple necrosis without periosteal reaction. (2) In the long bones an intense necrotic process was seen at the ends of the long bones beneath the epiphyseal line. At bone ends not bearing an epiphysis the lesion lay directly under the joint surface. Surrounding the end of the bone was a mature osseous periostitis which was

very striking in amount. Secondarily openings were burrowed through this involucrum and pus discharged into the surrounding tissues to form the deep subcutaneous abscesses common to the disease. Seldom were the joints involved, and then only by this burrowing process.

As you see from Dr. Bowman's slides the lesions of coccidioidal disease produce a less apparent liquefaction necrosis in the sub-epiphyseal region, have a less pronounced and more ragged periosteal reaction, and show changes in the joints affected. These are the first slides I have seen from this California disease and I confess having thought the lesions were identical with blastomycosis.

Dr. G. E. Pfahler.—I would like to ask Dr. Bowman what the treatment is for this condition. It has seemed to me from observation that there has been less general atrophy than one finds in lesions of tuberculosis, and that the disease is more sharply separated from the surrounding bone. From some of the slides it would appear that the bone was increased in density in the neighboring parts, while in tuberculosis there is a decrease.

Dr. H. K. Pancoast.—I have understood from talking with Dr. Bowman that the appearance of the chest in coccidioidal granuloma was practically the same as in early tuberculosis, and it seems to me that the Society would be interested another year in hearing from him a paper on the lung manifestations of this disease.

Dr. L. T. LeWald.—I wonder whether Dr. Bowman would not regard that as dislocation of the wrist, the semilunar retaining its relationship. I have seen one case in which there was a separation of the mid-row of carpals. I think in one of the slides that Dr. Bowman showed, the semilunar retained its relationship with the radius, but the os magnum had slipped backward and gave a prominent appearance to the semilunar; it was not, however, true dislocation of the semilunar.

Dr. William B. Bowman.—In regard to Dr. Moore's question as to whether or not a routine examination was made of the lungs, will say that in only three of these cases were the lungs examined. In all three, the roentgen findings were negative.

In regard to Dr. Pfahler's question as to the treatment of the disease, I will read first the therapy given in some of these cases: Sodium iodide, no result; tartar emetic, no result; copper sulphate, no result; autogenous vaccines, no result. Personally, I would like to see some of these cases treated with the *x*-ray. If *x*-ray will cure blastomycosis, it might have some therapeutic action on this disease, but there is nothing in the literature on this subject, with the exception of one reference in Dickson's article, in which he stated the *x*-ray had no results.

In regard to the question as to whether the organism is the same as that found in rabbits, will say that it is not. The name of this disease is really a misnomer. It is due to a mould-like growth and not due to protozoa.

REPORT OF TWO CASES OF XERODERMA PIGMENTOSUM WITH MALIGNANCY OF THE EYEBALL SUCCESSFULLY TREATED BY ROENTGEN RAY*

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XERODERMA PIGMENTOSUM is a disease of the skin characterized by extreme atrophy, pigmented spots, and later by the development of malignant growths. The condition resembles to an astonishing degree a chronic *x*-ray dermatitis, or the malignant degeneration we sometimes see in the aged. It nearly always starts in childhood and occurs in family groups. The two cases herein reported are brother and sister. According to the patients' statement, a similar condition prevailed in the father's sister, the father's father and the father's grandfather. The striking peculiarity in our cases was the occurrence of malignant lesions of the eyeball, involving both eyes in one case and one eye, the right, in the other case.

FIG. 1. CASE I. RESULT AFTER TREATMENT. The right eye is artificial, having been lost after unsuccessful treatment by operation and radium.

CASE I. Lena R., female, aged sixteen. Referred August 1, 1917, by Dr. Stanley Smith for treatment of a malignant lesion of left eyeball. About one year ago, a small growth appeared on right eyeball which was removed by Dr. Smith and section made, which proved the growth to be carcinomatous. It returned in a short time and was treated by radium, but the treatment was unsuccessful and the eye had to be removed. About one year later, a similar growth appeared on the left eyeball at the cornea-scleral junction on the nasal side. It increased rapidly in size and as operative and radium treatment had proven unsuccessful in the other eye, Dr. Smith immediately referred this case for *x*-ray treatment. At that time she had a reddish yellow growth, wedge shaped, about 3/8″ long, 1/8″ wide at base of wedge and elevated to a height of about 1/6″.

Because this patient had but one eye, we proceeded very cautiously with the treatment, and used a technique entirely different from the one we usually employ for superficial carcinoma. The eye was first cocainized to enable the patient to open the eye wider and to hold the eyeball still; a mask of tin foil was fitted, with an opening corresponding to the lesion. About one-third of an erythema dose was applied at each sitting, no filter being used. Treat-

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ments were applied every third day with occasional intervals of rest of a week or ten days. Fifteen treatments were given in all, the last being given Oct. 4, 1917, two months after the first. At that time the growth had entirely disappeared, only a small transparent scar remaining. The condition has remained cured to this date, two years later. In addition to the lesion on the eyeball, this patient had innumerable pigmented spots all over the face and forehead, some of which had broken down and formed small ulcerations. She said these spots had been present as long as she could remember, although her mother said that when she was a small baby she had not a blemish on her skin. We called in consultation Dr. John G. Burke, who pronounced the case one of xeroderma pigmentosum, and advised us to try x-ray treatment on the skin lesions, as no known treatment was particularly successful. We treated in all eight discrete epitheliomata which had ulcerated, using the regular massive dose treatment commonly employed for epitheliomata. In addition, we treated the entire forehead, which was thickly sprinkled with keratotic pigmented spots, with smaller doses through a thin filter. The ulcerated areas all responded to treatment and the condition generally was much improved. At this time there are no areas on the face which could be called malignant, although the skin is much atrophied and there are many scars and many pigmented spots. The final outcome of this case is of course problematical, but the remaining eye has been saved and the disease on the face halted for the time being. From the manner in which the epitheliomatous lesions of the face responded to x-ray treatment, I would feel quite hopeful of keeping this case going indefinitely, provided she seeks treatment promptly as soon as fresh lesions occur.

FIG. 2. CASE II. Note tumor on inner side of right eyeball.

FIG. 3. CASE II. Result after treatment; no appreciable scar.

CASE II. Justine R., male, age sixteen. This boy is a brother of Case I. He presented himself on June 16, 1919, with a growth on the right eyeball on the nasal side of the cornea, slightly smaller than

the one described in his sister's case. He had noticed it only a few days before and came immediately for treatment. He also had many pigmented spots on the face, and several small ulcerations, one of which had the typical pearly indurated borders of an epithelioma. Owing to the peculiar interest of these two cases, I had consultations on both with two dermatologists of Pittsburgh, Dr. Lester Hollander and Dr. H. G. Wertheimer. The diagnosis of Xeroderma pigmentosum was agreed upon by both these gentlemen, and the same treatment was carried out in this case as described in Case I. Small fractional doses were applied, since the result in the first case was so satisfactory, although I am of the opinion that massive doses could have been used with the same success.

In fact, in the interval between the treatment of these two cases, I treated successfully a malignant growth on the eyeball, almost as large as a grape, with one massive dose. However, we deemed it expedient to treat this case in a manner similar to Case I, and accordingly ten treatments were given of about one-third erythema dose each every third day, the last treatment being given July 28, 1919. At this date, August 30, 1919, the lesion has disappeared, leaving no appreciable scar. We also treated five small epitheliomata scattered about the face by the massive dose method and these have all yielded to treatment. The general condition of the skin in this case is not so bad as in Case I, and I believe we can cure up the epitheliomata by x-ray treatment as fast as they develop if he comes in promptly for treatment.

THE OPEN METHOD OF SURGERY IN DEEP-SEATED RECURRENT CANCER PREPARATORY TO ROENTGEN AND RADIUM THERAPY*

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THE RELATIVE ABSORPTION OF RAYS BY SKIN, FAT AND MUSCLE, AS COMPARED WITH VARIOUS THICKNESSES OF ALUMINUM *

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TECHNIQUE OF RADIOTHERAPY *

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THE roentgenologist is at a great disadvantage when he is to apply deep therapy to recurrent deep-seated carcinoma. Such cases are usually referred to him by the surgeon, because further surgery is inadvisable and because he wishes to preserve the hopes of the patient who, in his despair, is most anxious to try something more which might save his life.

Surgeons as a rule do not expect very much from radiotherapy. They recommend the treatment partly because there is nothing else to be done, and because they do not wish to deprive the patient of the possible chance of cure which this treatment might accomplish, for we do not as yet know its possibilities. The pessimism of the surgeon is in a large measure justified, because statistics in the past have shown that deep-seated recurrent carcinoma cases have rarely been permanently benefited by roentgen or radium treatment. But does this indicate that they never will be? Have we exhausted all our means to perfect the treatment of these cases? Shall we give up in despair, or shall we increase our efforts and improve our means to crush this most malignant foe of man?

I am convinced that radiotherapy will in the future increase its usefulness in the treatment of cancer, and we must keep on working unceasingly on the problem. One of the most essential requisites for efficient radiotherapy in recurrent cancer cases is the proper preparation of the cancer field, and this important factor is overlooked by surgery. The surgeon heretofore has not prepared the area for treatment for the roentgenologist so that he may apply roentgen therapy to its full capacity. To this particular shortcoming on the part of surgery I have given attention during the past few years, and have carried on certain experimental work (here reported) which I trust will lead a step forward in the treatment of some recurrent types of carcinoma.

This, then, is only a preliminary report on the experimental work done at the North Chicago Hospital on these apparently hopeless cases of recurrent, deep-seated carcinoma. Each case in which the treatment here described has been em-

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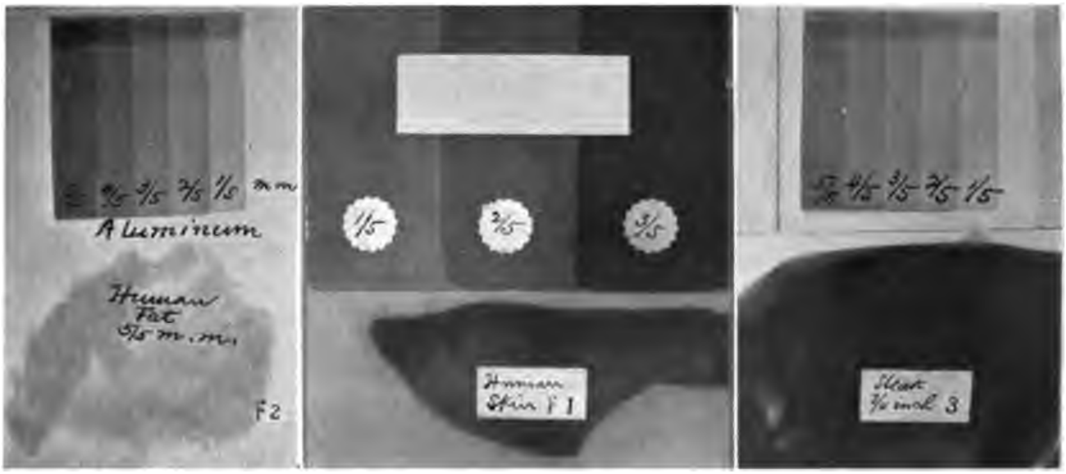
ployed has had previously at least one or more surgical operations, always with recurrence, and in each care all further treatment was considered valueless.

Method of Treatment.—The treatment consists of radical surgery followed by deep therapy. In this one apparently finds nothing new. Surgeons have for many years advocated deep roentgen therapy subsequent to surgical operations for cancer, and no doubt a great deal has been accomplished in this way. The new feature which I desire to add is the transformation of the deep-seated cancer field into a superficial one in the recurrent cases, thus preparing it for effective roentgen or radium therapy. To achieve this *I recommend the removal of all tissues, skin, fat, muscle, and as much of the tumor as feasible, leaving the cancer bed widely exposed in order that the rays may penetrate directly into the seat of the malignant growth.*

It is a well-known fact that superficial malignant growths, such as epithelioma, respond readily to *x*-ray and radium treatment, while deep-seated growths do not. The cause for this is very suggestive. The skin, fat, and subcutaneous tissues which usually overlie deep-seated cancer, are dense filters for the penetration of the *x*-rays. They absorb most of the softer rays from the *x*-ray tube and allow only a small quantity, namely, the hard rays, to penetrate deep enough to reach the growth. Such small quantities of radiation, instead of destroying the cancer cell, may stimulate it to more rapid growth. It therefore suggested itself to me that if we could remove the skin and all the overlying tissue and as much of the growth as feasible, and leave a large area entirely exposed, and then apply either *x*-ray or radium directly to the open wound, we might by this method obtain results similar to those usually obtained in superficial growths.

The physicists teach us that the rays emanating from radium consist of three varieties: alpha, beta and gamma rays. The alpha rays constitute 91 per cent of all the rays emanating from radium, the beta rays about 7 per cent, the remainder, gamma, only about 2 per cent. The alpha rays are very readily absorbed by thin metal foil or even by the air. Rutherford states that a thickness of 6/1000 cm. of aluminum or mica, or even a sheet of ordinary writing paper, is sufficient to absorb completely all the alpha rays. Most of the beta rays are absorbed in 5 mm. of aluminum or 1 mm. of lead. Only the gamma rays will penetrate these filters.

The density of tissues depends upon the close packing of the molecules which



Figs. 1, 2 and 3. Illustrate the Comparative Density of Shadows of Various Thicknesses of Aluminum, as Compared with a Certain Thickness of Human Skin, Fat, and Muscle.

compose them—in other words, on their atomic weight. In fat, for instance, the molecules are far apart, while in the skin or muscles they are more closely packed, and in metals such as lead or silver the molecules are extremely dense. The shadows on the photographic plate of these different substances give us an approximate indication of the molecular composition. Lead will produce a very dense shadow, while fat or muscle will give a correspondingly lighter shadow. For a rough working rule it may be taken that *the thickness of matter required to absorb any type of rays is inversely proportional to the density of the substance.*

the penetration of the x-rays; it produces a shadow on the x-ray plate equal to that of three-fifths of a millimeter of aluminum, because of the arrest of the rays by the skin. Where the underlying tissues, such as muscle, fat, and fascia, absorb still more of the rays, it is most likely that very few of the beta rays ever reach the deep-seated tumor. Thus we deprive ourselves of the action of the greater part of the most effective rays emanating from radium, namely, the beta rays. Even the gamma rays lose some of their intensity in passing through the skin and subcutaneous tissues.

To determine just how much of the x-ray is absorbed by the skin, fat, and muscle, we have two methods at our disposal: One is the *photographic* method and the other the *electroscopic.*

FIG. 4. ILLUSTRATES IN THREE CASES OPERATED IN JULY, 1919, THE EXTENT OF REMOVAL OF TISSUES OVERLYING DEEP-SEATED CANCER OF THE NECK. Short histories in text.

Thus the alpha rays have very little effect in the treatment of either superficial or deep-seated growths. The beta rays, however, are about one hundred times as penetrating as the alpha rays and the gamma rays are from ten to one hundred times more penetrating than the beta rays. The alpha rays may therefore be entirely ignored as far as the treatment of cancer is concerned, and we must depend entirely upon the action of the beta and gamma rays. Are we at present utilizing the beta and gamma rays to their full extent? Answer: We are not. The skin, being the densest of all the soft structures of the body, is itself quite an obstacle to

I have made the following experiments by the photographic method to determine the quantity of x-ray absorbed by the tissues:

1. A piece of *skin,* free of fat, removed from the knee of a young man, was placed on an x-ray plate and beside it were placed three strips of aluminum of various thicknesses: .2 mm., .4 mm. and .6 mm. thick respectively. Comparing the shadows produced by the aluminum with that of the skin upon the plate, we can estimate approximately the relative amount of rays

absorbed by the skin. (See Fig. 1.) It appears that the skin absorbs about as much as three-fifths of a millimeter in thickness of aluminum, which is considered by roentgenologists a substantial filter for the rays.

2. A layer of *fat*, ½ inch thick, was placed along a series of five aluminum filters ranging in thickness from .2 mm. to 1 mm. A radiogram for comparison of these two substances was made in a way similar to that in the case of the skin experiment, and it is shown that one-half inch of fat will arrest on the average as many rays as two-fifths of a millimeter of aluminum would filter. (Fig. 2.)

Fig. 5. Complete Closure of Wounds Subsequent to Radical Operation with Plastic. Recurrence took place after this operation. Fig. 6. Subsequent Operation, Leaving Wound Open, Radium Inserted. Fig. 7. Growth of Skin in the Depth of Excavated Bone Subsequent to Radium Ttreatment. Patient under observation.

3. The same experiment as No. 2 was made with *muscle* tissue. A piece of beefsteak, ¾ inch thick, was placed alongside the filter-scale and the shadow produced by the beefsteak is at least three times as dense as that obtained from 1 mm. of aluminum. (Fig. 3.) Thus it would appear that three-quarters of an inch of muscle would be capable of absorbing most of the beta rays from radium.

The measurements of the absorption of rays by means of the electroscope are more accurate, and have been conducted through the courtesy of Professor Millikan at the Ryerson Laboratory of the University of Chicago. The report of this work is here included. Their measurements show that our photographic estimates are approximately correct.

Taking these physical characteristics of the rays into account, I have therefore concluded that in order to have a full measure of the effective x-rays reach the tumor, we must remove the obstruction to their passage, namely, the skin, the fat and muscle, and as much of the tumor as possible. The procedure will be best understood by the illustration of cases, because the operation must of necessity be different in each case.

For illustration I cite four cases of different types from a larger series in which this treatment has been employed. We must bear in mind that we are attempting the almost impossible and cannot expect that a magic cure will follow in miraculous fashion in every case. If we can improve only in a small degree upon previous methods, we are taking a step in the right direction, which may finally lead to fruitful results.

The method is based on scientific principles, and while the number of cases thus far treated is not sufficiently large to draw definite conclusions, the results are encouraging enough (considering the hopelessness of these cases) to justify us in its application. The patients are usually per-

fectly willing to undergo one more operation, because they have usually lost all hope of getting well.

To what extent we may go in the removal of the tissues overlying the cancer, is illustrated in Fig. 4, showing three cases of recurrent carcinoma of the neck, all of whom I operated in July, 1919, being treated with radium and x-ray. The complete histories of these three cases will appear in future publications when time will permit us to make comments upon the efficacy of this method. At present I can speak only of the extent of the operation.

In Case A, I have removed the submaxillary gland and all the tissues overlying it, including the skin, fat, and muscles covering the transverse remus of the mandible. You note that the mandible is entirely bare and exposed. Into this deep crater the radium or x-ray is applied.

In Case B, a more radical operation was performed, the external ear was temporarily displaced and the internal ear was curetted, part of the cheek removed, and the entire area of the neck, including the supraclavicular region, which was exenterated and left exposed. The carotid and jugular in this case were excised.

In Case C, a similar procedure was pursued, the jugular was divided, but the ear in this case was not involved and therefore was left intact. The depth of the wounds is best demonstrated by viewing the stereoscopic pictures.

FIG. 8. REMOVAL OF SUPRA-CLAVICULAR INVOLVEMENT SUBSEQUENT TO REMOVAL OF THE BREAST. Wound left open.

FIG. 9. COMPLETE CLOSURE WITHOUT RECURRENCE 7 MONTHS SUBSEQUENT TO OPEN METHOD OF RADIUM AND X-RAY TREATMENT.

CASE REPORTS

Carcinoma of Jaw—Open Method for Deep Therapy.—H. H., age sixty, developed a carcinoma of his lower left lip, which was removed in July, 1915. In 1917 he developed carcinoma of the glands in the neck. A radical operation was performed in October, 1917, by myself, resection of the submaxillary gland and all the lymphatics on that side, as well as a resection of the tumor in the mouth and part of the lip. A large amount of skin overlying the maxillary bone was removed

and a flap of skin was shifted over to cover the defect. Healing took place within two months (Fig. 5); but by July, 1918, recurrence had extended to the lower maxillary bone. Another radical operation was performed; I resected the lower part of the transverse ramus of the lower jaw and all the overlying tissue, and curetted the ascending ramus of the jaw. This time, however, the wound was not closed, in order to allow the radium and *x*-ray treatment to be given directly into the center of the disease. (Fig. 6.)

Under this treatment healing took place rapidly, the skin gradually grew over the denuded area. (Fig. 7.) The patient remained perfectly well until April, 1919, when he developed severe headache and earache. It was uncertain whether there was any recurrence high up under the cranium, but there probably was. There was no recurrence, however, in the neck or at the seat of the operation which was treated by the exposed method. The patient is still under observation. Lesson: The last operation should have been more radical.

Recurrent Cancer of Breast—Supraclavicular Denudation.—Dr. J. C., age forty-eight, married, one healthy child. Developed carcinoma of her left breast in June, 1918. Although it was rapidly growing and she was fast losing in weight, she refused the removal of the breast until September, 1918, when all axillary glands were involved and a noticeable mass was seen above the clavicle. The breast was removed in September, 1918, with radical removal of all glands and muscles below the clavicle, but not above. Daily *x*-ray treatment was given after the operation to reduce the involvement in the supraclavicular region, but instead of a reduction the growth increased in size and the arm became swollen.

I then decided upon the removal of the skin, fat, and all cancerous involvement above the clavicle within reach. This was done on January 21, 1919. An area of 3 inches in width and 5 inches in length was denuded; the clavicle was entirely exposed; as much diseased tissue above the clavicle as was feasible was extirpated; no attempt was made to close the wound. (Fig. 8.)

Through the wound daily *x*-ray treatments for one month were given, and radium was applied once a week for 12 hours. The crater gradually filled up with what appeared to be normal granulation tissue. February 1, 1919, we began application of adhesive plaster along the edges of the wound for the purpose of favoring regeneration of the skin. This proved satisfactory, and at present the entire wound is covered with dry skin and no recurrence of the cancer has as yet taken place (Aug. 14, 1919). (Fig. 9.) Patient has regained her former weight and resumed her practice.

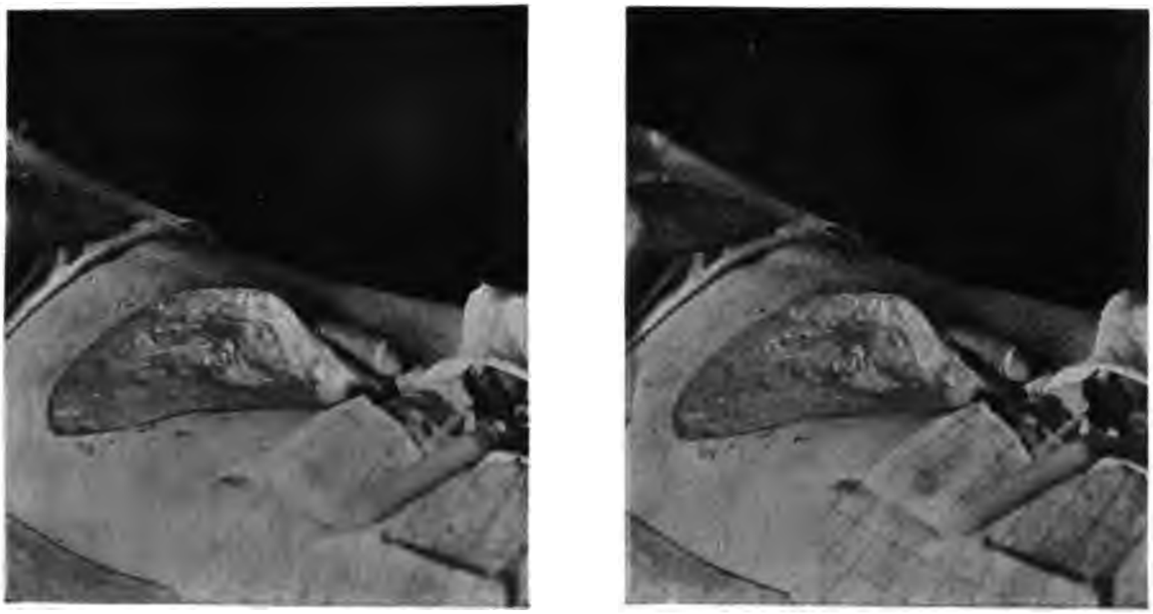
Cancer of Neck with Recurrence after Two Operations. Third Operation with Open Wound. No Recurrence.—Mr. A. L. M., fifty-four years old, developed a cancer of the lip early in 1916. The same was excised and for several months there was no recurrence. In November, 1916, several glands in the region of the sternocleidomastoid were found and a radical excision of the same was made. Recurrence took place after this operation. Patient would not submit to a more radical procedure until the tumor was of considerable size, when in March, 1919, a very radical operation was performed by us. *X*-ray treatment and radium were then applied almost daily over the sutured wounds, but recurrence took place as quickly as before, and within three months there was a tumor the size of an orange in the submaxillary region, the original seat of the trouble.

In this desperate condition the patient presented himself to me and I proposed the open method of treatment, which was carried out as follows: A circular flap with the base pointing to the lower jaw was lifted up and all of the tumor mass that could possibly be removed was eliminated. The skin flap was then pushed underneath the inner ramus of the jaw and kept there by gauze packing. This left the wound exposed. (Plate I in colors.)

Into the depth of this wound 10 milli-

Plate I. Removal of recurrent carcinoma (third operation), wound left open, for radium.

Plate II. One and a half years after operation, denuded surface entirely covered with new skin grown from the edges, no recurrence up to date, patient gained 30 pounds.



Stereophotograph A. Open operation in recurrent carcinoma of inguinal glands.

grams of radium element were inserted for 24 hours. This was repeated every week, besides the daily exposure of the wound to the x-ray. The patient began to gain in weight rapidly (20 pounds to date), the skin began to grow into the wound by the aid of adhesive plaster, and now, one year and a half later, the patient is in perfect health without a sign of recurrence. (Plate II.)

Another illustration of the extent to which we may proceed in resecting carcinoma in the inguinal region is shown in

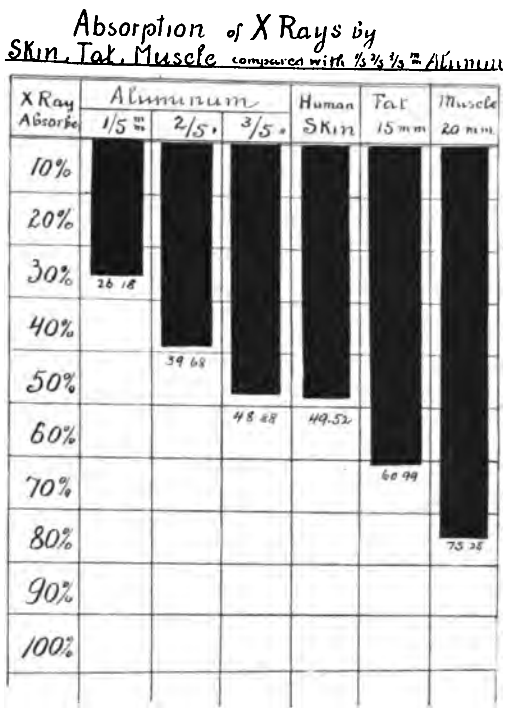


FIG. 10. CHART DEMONSTRATING RELATIVE ABSORPTION OF X-RAY BY VARIOUS SUBSTANCES.

the colored Lumière stereophotograph. In this case there was a most extensive involvement of the inguinal glands, the lower part of the abdominal muscles and the glands in Scarpa's triangle, subsequent to a primary carcinoma of the scrotum. All the tissues overlying the tumor and as much of the tumor, including Poupart's ligament, as possible, were removed in January, 1919, and the large surface shown in the picture left open for subsequent radium and x-ray treatment.

Rapid improvement followed at first, and all vestiges of the tumor almost disappeared, so that the patient could travel to Detroit to be presented before the Midwinter Meeting of the Western Section of the American Roentgen Ray Society; but later metastatic tumors appeared in the right inguinal region, which were excised early enough to prevent involvement of the deeper structures. Unfortunately, the patient had a severe hemorrhage from an erosion of the femoral vein on the left side, the first involved, which caused his sudden death.

Whether there will be any recurrence of metastatic tumors in other parts of the body is another question. It is likely that there will be. The susceptibility to cancer recurrence in what is called a cancer individual may still remain even if the growth in a particular region is destroyed.

It has been stated by some observers that there are changes in the entire body after the x-ray treatment which immunize the patient against a recurrence; but this is too large a subject to be discussed in this paper.

What becomes of this large denuded surface after the growth has apparently disappeared? The skin from the borders of the wound will gradually grow from the edges and cover the entire surface with the aid of the adhesive plaster method, which I have published in the *Annals of Surgery*, April, 1919. This growth of skin in itself is proof that the cancerous growth has been eliminated, because healthy epithelial cells will not grow over cancer tissue. But I have observed in the cases treated that the skin will cover large surfaces which formerly contained masses of cancerous tissue.

I present this subject in this immature state merely that others may try it and help perfect the surgical as well as the roentgen technique. It certainly can do no harm, and may accomplish some good to these poor individuals who have nothing to look forward to but misery and death.

DR. WARNER'S PAPER

A HYDROGEN tube with tungsten target was used, excitation being produced by a transformer and rotary rectifier (Victor). The absorption was measured by an ionization method. The distances 16 and 32 inches refer to the distances from the target to the window of the ionization chamber. The numbers are percentages of the total incident rays absorbed; e g., one aluminum screen absorbed approximately 25 per cent of all the rays falling upon it in the conditions given in Table I. The aluminum screens were of standard type but varied from 0.20 to 0.23 mm. in thickness. Since the time of exposure was of necessity very short, and because the effect from equal short intervals of time are not equal (due to the variations in the primary current), no attempt was made to keep the time intervals constant, but in general it was somewhat longer for the 32-inch distance than for the 16-inch distance.

In Table I two sets of data were taken for the 16-inch distance for each absorbing substance. A comparison of these results shows that the per cent of variation is in all cases less than 1 per cent. Comparing the results for the two distances shows that for short distances there is practically no difference in the percentage of absorption, hence in the remainder of the work the 32-inch distance was used.

In Table II the same absorbing substances were used as in Table I but with the addition of three other substances. The heterogeneous rays were obtained with the same conditions as before except that the voltage and consequently the current through the tube were increased slightly. The medium hard rays were obtained by screening out the soft rays, by interposing a piece of plate glass between the tube and the ionization chambers.

The great variation in the two samples of skin is easily accounted for by the fact

TABLE I

Conditions: Victor H. Tube, Tungsten target. Spark 5 inches. Current 1.2 milliamperes.

Absorbing Substance	16 inches	32 inches
One Al screen	25.06	
	25.18	24.07
Two Al screens	37.48	
	37.14	37.18
Three Al screens	45.40	
	45.04	45.06
1st sample skin	46.45	
	46.65	46.48

TABLE II

Conditions: Victor H. Tube, Tungsten target. Spark 5.5 inches. Current 1.6 milliamperes. Distance 32 inches.

Absorbing Substance	Heterogeneous	Medium Hard
One Al screen	26.18	
Two Al screens	39.88	
Three Al screens	48.88	
1st sample skin	49.32	
2nd sample skin	17.91	8.08
Fat 15 mm. thick	60.99	31.49
Beef 20 mm. thick	75.25	42.88

FIG. 13. ILLUSTRATES THE COMPARATIVE FIGURES OF RAY ABSORPTION BY VARIOUS TISSUES.

that the first sample was much thicker and of more uniform thickness than the second.

The slight increase in percentage absorption with increased voltage would at first seem to indicate that the absorption is greater for hard rays than for soft: but since when all the soft rays are screened out by interposing the plate glass the percentage absorption is cut down approximately one half, the explanation is no doubt that while increased voltage did produce some harder rays it also produced a proportionally greater number of soft rays, thus increasing the percentage absorption for the heterogeneous beam. The very great decrease in percentage absorption for the harder rays seems to be a plain indication that the fleshy tissues are quite transparent to hard rays.

It is usually unwise to attempt to draw a conclusion from incomplete data; but it seems safe in this case to predict that a few centimeters of body tissues would act effectively as a screen for nearly all the soft rays, but would be quite transparent to hard rays. Hence if it be the soft rays that are valuable in therapeutics the removal of parts overlying the diseased organ is quite essential: but if hard rays are the valuable ones, then removal of the overlying tissues seems unnecessary.

DR. EISEN'S PAPER

WHEN treating cancers in which the overlying skin and other tissues have been cut away, the treatment becomes practically the same as in epithelioma. The only difference lies in the amount of x-rays or radium given; the quality of the rays remains unaltered. The time of exposure depends upon the depth to which the cancer reaches and upon the toleration of the patient to the rays. It is therefore obvious that no two cases can be treated alike, and each individual application is dependent upon the patient's general condition.

The local reaction of the rays cannot of course be judged by the reaction of skin to the rays. Until this new treatment was introduced, the amount of rays given to a cancer was dependent upon the toleration of the overlying skin. The limit which the skin tolerates is that causing a reddening (an erythema) within twenty-four hours. This is called an erythema dose and differs according to the locality of the skin, but varies only within certain limits, and can be accordingly pretty accurately estimated.

With the removal of this skin, the appearance of the cancer-bed and surrounding tissue furnish the signs for measuring the permissible dose. This dose, in our experience, has been many times the dose tolerated by the skin. We have given ten, twenty, and even more full skin or erythema doses in as many successive days. Such doses could never be given when skin covers the cancer. A superficial green-colored necrosis, less than ⅛ inch thick, follows this rapid-fire treatment. In a few days, the dirty-looking connective tissue returns to its original pink, in which the scattered islands of persistent cancer areas still remain discolored. Later this deeper necrosis sloughs away, the easy-bleeding cancer islands reappear, the treatment is then renewed.

The only filter against the soft rays of longer wave length used is a four thickness piece of gauze placed over the wound and a sheet of writing paper placed over this. No other screening material is used. To insure greater stability and easier management, the tube vacuum is kept very high (12-inch back-up) and the amount of rays generated is very small (½ milliampere). This makes the repetition more exact and also insures a large amount of the more efficient soft rays, as the tungsten spectrum for rays of different back-up will easily demonstrate.

It is needless to say that the body.

except the raw wound surface, is accurately covered with material (lead rubber) impervious to the rays. The tube is brought down as near the wound surface as possible (about 6-inch focus distance). Sometimes it is unavoidable to expose some point of the skin, which then becomes edematous and temporarily painful. It has also happened that the protected skin has become hyperæmic in highly sensitive patients, either through the amount transmitted through the protective material or possibly through secondary rays generated in the patient's body.

Sleeplessness, loss of appetite, and general weakness are the signs of general toxemia. At this point further treatment is for a time suspended. At no time have patients become ill during or shortly following the treatment, which lasts between five and ten minutes, never longer. It is too early to give a more extensive report, inasmuch as the method is in the experimental stage.

LATE RESULTS OF WAR INJURIES TO THE CHEST

BY HENRY JANNEY WALTON, M.D.*†

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THIS meeting will have achieved a helpful end if it impresses upon our minds the advancement in medicine and surgery during the past few years, although for part of our knowledge we have paid dearly in the hundreds of thousands of lives lost and shattered. What seems rather remarkable is that the war has failed to produce anything new or startling in medicine; but it is the aggregate of smaller refinements and perfections which mark the great progress in the past five years. Probably the greatest advance in any branch of medicine during the war has been in thoracic surgery.

During the first two years of the war very little was attempted surgically for gunshot wounds of the chest, as in civil practice experience had demonstrated that the best method was to treat these cases expectantly. With the very large number of extensive wounds of the chest demanding treatment, and showing a general mortality of over 30 per cent, chest wounds became regarded as among the most serious of all war injuries, and surgeons began to apply more heroic methods in order to save the lives of these patients.

Duval, Gask and others, disregarding the old established theory of negative pressure, began to treat these wounds exactly as they would similar wounds in other parts of the body, thus reducing the mortality to about 9 per cent. They found that the thorax could be widely opened, the collapsed lung delivered through the wound, the lung incised, foreign bodies removed, and the lung sutured; the pleural cavity washed out, and the pleura, chest wall and integument closed in turn by primary suturing, without causing either shock or injury to the patient.

The principal causes of death in chest wounds are infection and hemorrhage; therefore the greatest success followed in those cases which were operated upon within a few hours after injury. Duval states that as a rule it is best not to perform any operation after 30 hours. He recommends immediate thoracotomy under the following conditions:

1. In cases of serious hemorrhage.
2. Open thorax and mechanical difficulties in respiration (sucking wounds).
3. Foreign bodies retained in the lungs, unless very small.
4. All wounds of the lungs complicated with fracture of the ribs.
5. Wounds of the lungs with an intrapulmonary hematoma.

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† Authority to read and publish this paper was obtained from the Board of Publication, Surgeon General's Office, Washington, D. C.

The success which has followed this newer method of treating lung wounds in carefully selected cases, must not blind us to the great danger involved in opening the thorax. It has been proven that very few rifle bullet wounds give trouble unless the bone is injured; and shell fragments, if small, can penetrate the chest wall and lodge in the lung without apparently causing any permanent damage. If the ribs are splintered or if the wound of entrance or exit is large and there is reason to suspect that particles of clothing or foreign material have been carried into the wound, débridement should be practiced in the same way as in other parts of the body.

Col. Rudolf of the C. A. M. C., in collecting notes on patients in the Canadian hospitals in England with foreign bodies in the chest shown by *x*-ray examination, cites 50 cases. Two of these were operated upon for the removal of foreign bodies, and both patients died; one from hemoptysis eleven days after operation, and the other from pulmonary thrombosis on the third day. Of the 48 not operated upon, 29 were returned to full duty, 7 to light duty, and 12 were invalided to Canada. Thus 72 per cent were fit for some form of military duty while 14 per cent were lost to the army.

Col. Elliott, F. R. C. P., of London, gives a list of 170 cases of gunshot wounds of the chest, in which the after history had been traced. He states that the only case that had a fatal termination was one in which there had been an operation for the removal of a rifle bullet from the lung. A foreign body remained in the chest in 51 of his cases, without apparently increasing the gravity of the prognosis in any instance.

My own personal experience and observations in wounds of the chest have not been great, for the wounded whom I saw at the Base Hospital at Camp Upton, N. Y., were for the most part convalescing from injuries received from two to ten months previous to their entrance into the hospital. Out of 568 roentgen examinations of the chest, made in January, February, March and April of this year, 33 were referred because of injuries to the thorax. These presented quite a variety of conditions.

Eight had through and through wounds of the chest with absolutely negative roentgen findings.

Two had double scars, with evidence of an empyema on the affected side, one showing the presence of fluid. Neither of these cases had been operated upon.

Two showed localized areas of increased lung density in the region of the scars.

Seven showed extensive thoracic wall wounds with injury to the clavicle, scapula or to one or more ribs. All of these showed visceral changes, ranging from slight thickening of the pleura to obliteration of all lung detail on the affected side. Three of these cases were draining.

One had a persistant hemothorax, not infected. This case was aspirated on Jan. 13th and again on March 9th, and over 1500 c.c. of a bloody serum was withdrawn both times. This man gave a history of having had fluid withdrawn several times in France.

Seven had foreign bodies in the lungs; 5 of these failed to show any fibrosis or thickening of the lung structure surrounding the missile. The largest of these foreign bodies was a machine-gun bullet which appeared to be suspended in space when the plates were viewed stereoscopically. One of these patients had had a radical operation with a resection of a part of the 6th rib, and there was a small foreign body near the base of the right lung. There were no signs of thickening of the pleura or of pulmonary changes, and had it not been for his history and the absence of the rib, one would never have suspected that a thoracotomy had been performed. In none of these cases was there evidence of abscess formation around the foreign body.

Six had foreign bodies in the chest wall, one showing several fragments beneath the integument.

With very few exceptions these patients looked and seemed well, and most of them were anxiously waiting to be discharged. Very few complained of any discomfort except a slight cough and occasional pain. These symptoms appear to be quite common, especially where there is a foreign body in the lung. How much of this discomfort is imaginary is a question yet to be determined, as it has been frequently observed that symptoms do not develop until the patient has become aware that his body is harboring a shell fragment or bullet.

In giving this general outline of the principles involved in the treatment of these cases, it is not with the idea of presenting anything new, but simply to emphasize the importance of the subject, as many of these patients after being discharged from the service will seek medical advice.

It is of the utmost importance in the treatment of these cases that there should be the closest cooperation between the skilled surgeon, the clinician and the roentgenologist. The roentgenologist must furnish very exact information as to the shape, size and location of the foreign body, the presence and extent of a hemothorax, pneumothorax or empyema, the extent of injury to the bony framework, the condition of the opposite lung, the position of the heart and movements of the diaphragm.

From the experience thus far gained it seems probable that in the immediate future the great majority of penetrating wounds of the thorax will still be treated by the expectant method, and by surgical cleansing of the external wounds. There will be comparatively few injuries that will require thoracotomy, but Gask, Duval, Lilienthal and others have demonstrated what can be safely undertaken in chest surgery, and it is not too much to expect that in the near future many of the disfiguring and protracted empyemas, lung abscesses, localized tuberculosis and new growths may be treated with far greater success by opening the thorax than by any of the older methods.

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ANALYSIS OF 1300 CASES REFERRED FOR GASTROINTESTINAL STUDY, WITH SPECIAL REFERENCE TO THE IMPORTANCE OF CHEST EXAMINATION OF SUCH CASES *

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AND

ARTHUR C. CHRISTIE, M.D.

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THE danger of limited examinations is well recognized by the best clinicians, and has been repeatedly emphasized. The importance of a more general roentgen survey in cases that are more or less obscure is also recognized by the roentgenologist; but the fact that both clinician and roentgenologist are derelict in this respect cannot be disputed.

The roentgenologist as a rule is only an accessory to this very obvious shortcoming, as the patient comes to him from the clinician with a request for an examination of some particular anatomical region or system; and with the meager clinical data at hand, it is but natural that he should follow the clinician's instructions to the letter. Indeed, at times when he presumes to violate these instructions his course is resented, until the physician referring the case is conclusively shown that it makes for more accurate diagnosis and a better understanding of the case in question. Cooperation is merely a matter of mutual understanding and confidence.

The fact that gastrointestinal symptoms frequently have their source of origin in lesions above the diaphragm is not sufficiently recognized. In order to emphasize this, the authors have undertaken an analysis of 1300 cases referred to them during the past two years for gastrointestinal examination. Of the 1300 cases our records show that a complete examination of the chest, both by stereoplates and the fluoroscope, was made in 807; fluoroscopic observation only was made in 304; and in 189 there is no record of the chest having been examined.

In tabulating our findings in these cases we have endeavored to record only definite pathology, and have eliminated as far as possible doubtful diagnoses and minor conditions which seemed to have no bearing on the case in question. Of course even with the utmost conservatism a certain degree of error is inevitable, as in a laboratory such as ours it is impossible to follow all cases to an ultimate diagnosis, either pathological or clinical. A variation in percentages in different laboratories is also to be anticipated, due to a difference in the character of the material handled, and the class of men referring cases.

Of the 1300 gastrointestinal cases forming the basis of this report we were able to demonstrate actual pathology in 506, or a little less than 39 per cent. Of this number the lesion was found to be in the chest in 170, or a little more than 13 per cent, or by excluding the 189 cases in which the chest was not examined, a little more than 15 per cent. In other words we found only about twice as many more gastrointestinal lesions than chest lesions in cases referred for gastrointestinal study.

It will be at once apparent that if our statistics are to have a practical rather than an academic interest, it must be shown that the chest lesion was an important or a prime cause of the morbidity in these cases.

With respect to the lung lesions this question can unhesitatingly be answered in the affirmative. This group comprised 98 cases, of which 84 were tuberculosis. The remaining 14 comprised cases of pleural effusion, unresolved pneumonia, spontaneous pneumothorax, malignant disease, pleural adhesions and bronchiectasis. The tubercular cases comprise about 6.5 per cent of the total number referred for

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gastrointestinal study, or more than 7.5 per cent of the cases in which the chest was examined. Coincident lesions of the lung and gastrointestinal tract were noted in only 6 cases.

The gastrointestinal symptoms which initiated a request for examination of the alimentary canal were of secondary origin in practically all of this group. Most of the tubercular cases were of a chronic, slowly progressing type, many of them showing extensive infiltration and fibrosis, but which nevertheless had escaped recognition throughout years of semi-invalidism. Of course a number of fairly early lesions were recognized, but this proved rather exceptional. It is of interest to note that we found pulmonary tuberculosis in almost exactly the same percentage of cases as duodenal ulcer, and it would thus appear that the two lesions are worthy of equal consideration in cases referred for gastrointestinal study.

The cardiovascular group comprised 69 cases, or slightly more than 6 per cent of the cases in which the chest was examined. A conspicuous enlargement of the heart or aorta was the determining factor upon which the presence of pathology was predicated. There was one case of aortic aneurysm. No attempt was made to determine accurately the heart volume by the more approved methods, our estimate being based solely upon visual impressions gained from observations made under standard conditions. The relationship of the cardiovascular lesions to the morbidity in this group of cases could not be determined with the same degree of assurance as in the pulmonary group, but it is certain that in many cases the roentgen observations in reference thereto were of great value in rounding out a diagnosis. It is to be noted that coincident lesions of the cardiovascular and digestive systems were more than twice as frequent as in the pulmonary group. These were noted in 11 of 69 cases of the former group, and in only 6 of 98 cases in the latter.

There is one important point in regard to the technique of chest examinations which we feel deserves special emphasis. We are convinced that fluoroscopic observations are not to be relied upon to the exclusion of stereoscopic plates. We believe all will agree with this conclusion; nevertheless we have been led to believe that there is a disposition on the part of some to rely on the easier and cheaper method, particularly in the examination of the chest in gastrointestinal cases. A minimum of error can only be obtained by a routine employment of both methods.

The accompanying table will show the pathological findings both in the chest and gastrointestinal tract of the 1300 cases forming the basis of this report. The percentages with respect to the chest lesions are estimated on a basis of 1111 cases, which comprise the total number in which the chest was examined.

TABLE SHOWING COMPARATIVE INCIDENCE OF CHEST AND GASTROINTESTINAL LESIONS IN CASES REFERRED FOR ROENTGEN STUDY OF THE ALIMENTARY CANAL

CHEST LESIONS

	No.	Per Cent
Pulmonary tuberculosis	84	.075+
Pleural Effusion	4	.003+
Unresolved Pneumonia	4	.003+
Spontaneous Pneumothorax	1	.001−
Malignant Disease of Lung	2	.002−
Pleural Adhesions	1	.001−
Bronchiectasis	2	.002−
Enlarged Heart	25	.022+
Dilatation of Aorta	43	.038+
Aneurysm of Aorta	1	.001−
Intrathoracic Thyroid	3	.002−
TOTAL	170	.150+

GASTROINTESTINAL LESIONS

	No.	Per Cent
Carcinoma of Esophagus	2	.001+
Cardiospasm	21	.016+
Gastric Carcinoma	24	.018+
Gastric Ulcer	33	.025+
Gastric Syphilis	3	.002+
Pyloric Obstruction	12	.009+
Duodenal Ulcer	89	.068+
Duodenal Diverticulum	8	.006+
Gall-Bladder Adhesions	14	.012+
Gall-Stones	18	.013+
Organic Lesions at Outlet of Stomach of Doubtful Nature	42	.032+
Intestinal Obstruction	3	.002+
Appendix Disease	26	.02
Colitis	2	.001+
Carcinoma of Colon	5	.004−
Diverticula of Colon	1	.001−
Colonic Adhesions	33	.025+
TOTAL	336	.255+

SOME OBSERVATIONS ON THE RADIOGRAPHIC FINDINGS IN A SERIES OF CHESTS EXAMINED AT A BASE HOSPITAL IN FRANCE *

BY FRANCIS F. BORZELL, M.D.

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WHEN we began this series we had hoped to make it more exhaustive than this present report would indicate, but owing to the changes forever occurring in the Army we were compelled to conclude with what we have presented here.

Our purpose was to determine as far as possible just what permanent structural changes, if any, took place in the lung tissues after inhalation of war-gases. In the main, we tried to secure cases who had a definite history of "gassing" as shown by the history card. We tried to exclude any with acute pulmonary conditions existing at the time of the examination.

In order to establish some differentiation if possible in the radiograph between changes due to such conditions as the recent "flu," the pneumonias, tuberculosis, or the effects of dust inhalation from exposure on hikes, etc., and gas inhalation, the cases examined are separated into five groups.

1. Those with a history of gas inhalation, with a negative pulmonary history: 32 cases.
2. Those with a history of gas inhalation, with a history of "flu" or pneumonia: 5 cases.
3. Those with a gas history, but referred by the clinician because of suspicious tuberculosis: 5 cases.
4. Those with positive recent pulmonary history without a history of gas inhalation: 34 cases.
   a. Influenza alone: 18.
   b. Pneumonia, bronchial or lobar: 8.
   c. Bronchitis: 4.
   d. Both influenza and pneumonia: 4.
5. Those with a negative pulmonary history and no exposure to gas, with exposure to dust irritation from long hikes, while in service: 11 cases.

It should be observed that virtually all gave a history of exposure to dust. Beginning with the last group, those with a negative pulmonary history but who had had a fair amount of dusty hiking, we found neither clinical signs of moment nor any radiographic evidence of pulmonary changes. Our conclusion was that the fact of exposure to dust inhalation from marching should have no influence on any radiographic findings in this class of cases.

The fourth group consisted of those with positive recent pulmonary history but without a history of gas inhalation. By "recent" we include a period within a year of the examination, but clinically not suffering to any great extent. Of the first subdivision of this group, namely, those with a history of "flu" alone, the findings were negative in two cases. Fourteen presented definite increase in the hilus shadows with a tendency in all toward extension along the basal trunks into the bases, particularly on the right side. These basal shadows were in almost all instances more marked than those often met with in radiographs of apparently normal lungs. This observation coincided with the clinical picture in a number of cases, where râles, ranging from harsh to fine crackling râles, were heard at the bases and mainly on the right side. Three cases, in addition to the hilus and basal changes, showed a fine beading along the bronchi and bronchioles, distributed evenly on both sides and all lobes. Three presented a "matted hair" appearance or interlacing of the finer linear markings at the periphery.

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Of these three, two had had pneumonia some years previously.

The second and third divisions of this group, those presenting no history of influenza, but with a history of pneumonia, presented only a tendency to increased peribronchial markings.

The fourth division, of which there were four cases, including those who had had both influenza and pneumonia, all showed a marked increase in peribronchial thickening and heavier hilus shadows with the basal shadows exaggerated.

The third group of five cases included ~~those~~ who had been definitely "gassed," but were referred by the clinician because of suspicious tuberculosis. All of these cases presented old calcifications in the hiluses, but no evidence of active tuberculosis. The peripheral markings, however, all presented the same fine, linear, interlacing or hair-net appearance seen in the cases included in Group 1.

The next group of five cases consisted of those with a history of gas inhalation but who had also had some pulmonary infection (pneumonia or influenza). Every case in this group presented marked increase in the hilus shadows, definite peribronchial thickening, often more marked at the bases, with the peripheral linear markings sharply defined, presenting again the "hair-net" appearance of the first group.

The last group to be considered, or the first group in the classification, 32 in number, were those who gave a history of "gas" inhalation with a negative history of recent pulmonary infection.

Three cases showed no definite changes. The remainder showed well defined linear markings at the periphery throughout both lungs. The hilus shadows were usually less dense than in Group 4, but often wider than normal and of a soft filmy character. A number showed discreet studdings along the bronchi. These changes were in the majority of instances confined to the middle and lower portions of both lungs. Rarely, if ever, were the upper portions and apices involved. The peripheral shadows were the most striking feature of this group. As before intimated, the appearance was not unlike matted hair. The linear markings were distinct, fine lines, interlaced, both peripheral and between the bronchioles, and throughout both lungs, mostly the middle and lower lobes. This is probably due to the fibroid changes resulting from the interstitial inflammation from which all apparently suffer immediately following the attack. Almost all of them had been exposed to the gas from three to four months previous to the examinations, which were made in January, 1919, most of these boys having been gassed in September and October, 1918. Virtually all still suffered from a dry and unproductive cough, and a sense of constriction or suffocation when in a crowded room.

The radiographs were made in the erect posture, stereoscopically, the rays passing postero-anteriorly.

CONCLUSIONS

Although I realize this is too small a number of cases to warrant the establishment of any definite conclusions, I gathered from this study that:

1. Exposure to dusty hiking produces little if any pulmonary pathology.
2. The effect of the so called "flu" is mainly upon the hiluses and peribronchial tissues, and basal rather than along the middle and upper trunks.
3. Inhalation of war-gases, it would seem, produced a fibroid thickening of the parenchymal tissues as well as of the finer bronchioles. This gives us a radiograph which appears not unlike fine matted hair at the periphery of the lung shadows and between the bronchioles, in other words, a pneumonitis.

I was greatly assisted in the choice of cases and their clinical study by Capt. Ralph M. Tyson, M. C.

MALIGNANT DISEASE OF THE LUNGS, ITS EARLY RECOGNITION AND PROGRESSIVE DEVELOPMENT, AS STUDIED BY THE ROENTGEN RAYS*

BY GEORGE E. PFAHLER, M.D.

PHILADELPHIA, PA.

PRECEDING the study of the chest by means of the roentgen rays, an antemortem diagnosis of malignant disease of the lungs, according to Warfield, was not made in a large percentage of cases because of the general good condition of the patients and the indefinite symptoms which this disease produces. Even with the study of the chest by means of the roentgen rays, I am sure that the disease is generally not recognized in its earliest stages. In its very earliest stages I believe that it cannot be definitely diagnosed by any means. In its latest stages it should not be mistaken by any roentgenologist. By reviewing the roentgenograms of a large number of cases, some of which have been followed over a period of several years, during which we have studied the progressive changes in the lesions, and by reversing the study, we have been able to trace the gross lesions back to their very incipiency. As a result, I am hoping that we shall be able to recognize this disease much earlier than it has ever been recognized heretofore. There is, of course, a microscopical stage in its development at which time we can never hope to recognize the disease.

Its early recognition will serve as a guide in the treatment. In some instances it will prevent a mutilating operation, and I am hoping in the future that its early recognition may lead to the early institution of some form of constitutional treatment which is as yet undiscovered. I am sure that at present many patients are operated upon with the hope of complete recovery at a time when there is already distinct metastasis in the lungs and mediastinum. On this account I believe we should urge a roentgen examination preceding all operations for carcinoma of the breast. When the lesions within the chest are doubtful, I believe that they should not stand in the way of an operation.

Malignant disease of the lungs may be divided into primary and secondary (or metastatic).

Primary Malignant Disease of the Lung is rare. It is of two types: the nodular and the infiltrating. The nodular type consists of nodules developing near the roots of the lung, but also in the parenchyma, and consists of varying sized masses, rather sharply defined and irregularly outlined. The infiltrating type, which is the more common, begins at the root of the lung and gradually infiltrates the entire lung. This fills the whole chest, and may come on so gradually, and produce such indefinite symptoms, that the disease is not suspected until the entire lung has become filled, and until one side of the chest is entirely solid, associated with marked displacement of the heart and mediastinal tissues to the opposite side, and associated with the early formation of pleural effusions.

The symptoms associated with primary malignant disease of the lungs consist usually of dyspnea, pain, with or without pleuritic friction, and dullness varying with the degree of the involvement of the lung. As a result of the extensive dullness, the first thought is a pleural effusion, but in aspirating the chest only a relatively small amount of fluid is obtained, and this is generally a bloody serum. When bloody serum is obtained in a relatively small amount, malignant disease should always be suspected, and a roentgen examination should be made if it has not been made

*Read before the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3–6, 1919. Illustrated by lantern slides.

previously. By means of the roentgen rays one recognizes an opacity in the early stages consisting of a mass of infiltrating dense tissue about the root of the lung spreading towards the periphery. If the malignant disease is sarcoma, it is especially apt to extend outward along the septum between the upper and middle lobe on the left side, or about the middle lobe on the right side, and this may be a fairly early sign. If the primary malignant disease is carcinoma, it consists of an infiltrating mass about the root of the lung extending outward along the bronchial tree, I believe most frequently in an upward direction, which serves somewhat to distinguish it from the inflammatory infiltrations about the root of the lung which tend to spread downward. In the late stages the whole of one side of the chest is a uniform dense mass with displacement of the heart and mediastinal tissues to the opposite side, with generally clear lung on the opposite side. The lung area on the opposite side may be reduced to one-third or more of its normal size. In less advanced stages the apex of the lung and also the lower portion of the base may remain clear, unless there is associated pleuritic effusion. Sometimes by varying the position of the patient this lower portion of the base of the lung can be demonstrated to be clear by displacement of the fluid upwards.

Secondary or Metastatic Malignant Disease of the Lung is very common, and I believe much more common than has been recognized up to the present time. In a quotation made by Warfield in the report of cases studied in Middlesex Hospital, he states that metastases were found in the lungs of 178 out of 516 autopsies performed on persons who had died from cancer of the breast, and he states that at least one-third of all patients dying from cancer of the breast have metastases in the lungs. It would seem to me, from my studies, that the proportion would be even higher than this. Gross found in 432 autopsies, collected from various sources, metastases in the lungs in 49 per cent. (Quoted by Rodman, p. 214.)

Metastatic Sarcoma, in my experience, has mostly followed sarcoma of the testicles, though it may, of course, be secondary to sarcoma anywhere in the body. The lesions are nodular and occupy more particularly the parenchyma of the lungs. They are generally sharply defined and vary in size from a small pea to an English walnut, or rarely as large as an orange. The emboli are probably carried to the lungs in the blood stream and distributed in the terminal blood vessels in the parenchyma. In none of the cases studied by me did the patients have any lung symptoms, and the disease in the lungs had not been suspected by the physicians who referred the patients—generally for treatment of some local recurrence or some other metastasis. This condition of metastatic sarcoma of the lungs occurs so frequently, in my experience, that I never start treatment of a sarcoma without examining the chest, and when metastatic sarcoma of this kind is found within the chest, the roentgen treatment has been of no avail.

Hypernephroma metastasizes early to the lungs, and I believe the chest should be examined in every case in which hypernephroma is suspected, or whenever hypernephroma has been diagnosed. In one case sent to me for postoperative treatment three weeks after the operation for hypernephroma, in which the patient's general condition was good and there was no thought on the part of others as to recurrence or metastasis, I made an examination of the chest and found undoubted evidence of infiltration of the lungs. This consisted, not of nodules, but of a general infiltration of small miliary bodies extending outwards from the roots of the lungs, which somewhat resembled an infiltrating tuberculosis, but the lesions were more sharply defined and did not follow the usual distribution of tuberculosis. The appearances were sufficient to make a diagnosis when associated with the history, and the subsequent development

proved that my diagnosis was correct. I am not sure that the diagnosis could have been made from the plates without the previous history.

Metastatic Carcinoma of the lungs, in my experience, has most frequently followed carcinoma of the breast. However, it must be admitted that I have had very much more opportunity of studying this group of cases than those belonging to malignant disease in any other part of the body. I have studied the chests in 225 cases of malignant disease of the breast. At present I make a chest examination of every patient referred to me for roentgentherapy for carcinoma of the breast, whether for the primary disease, ante-operative or postoperative treatment. There have been long intervals in the past when I did not follow this procedure. My experience now convinces me that this should always be done. Metastatic carcinoma of the lung is of four types:

1. *The Nodular Type*, which we have all recognized for many years, and which is characteristic as early as the nodules can be demonstrated. These nodules are generally distributed in the parenchyma of the lungs, though they may be located about the roots as well as in the parenchyma. These nodular lesions vary in size from that of a pinhead to an English walnut. They are generally not very dense or sharply outlined, but present a fuzzy appearance suggesting cotton balls. At times they are very dense and sharply defined. They are very much less dense and less sharply defined than metastatic sarcoma, though their distribution is very similar. This is the type that has been particularly studied and described by Moore and Carman. Apparently no other type was recognized by them at the time of the complete and able presentation of this subject before this Society in September, 1915. They describe the lesions as varying in size from the head of a small hat pin to that of an orange, and varying in density from a faint shading to a degree approximately that of the heart, depending on the stage of the disease. At the time of the presentation of this paper it was undoubtedly the most complete roentgenological study of this disease which had been made, and in general represents our knowledge of the subject up to that date. They had made a study of 71 cases. The character of the distribution of these lesions would lead one to suspect, as Moore and Carman also suggest, that these metastases are embolic and travel through the blood rather than through the lymph streams.

2. *The Infiltration Type* beginning at the hilus or mediastinum. This I believe is the most common and, as has been so well said by Holmes and Ruggles, is "unrecognizable in the early stages and unmistakable in the later ones." This begins as a general thickening or infiltration about the hilus which, in its earliest stages, resembles the inflammatory thickenings that we so commonly find in this region, but which I believe differs slightly in that it presents more localized density without outline at the very roots of the lungs. It then shades so gradually as it extends outward that it is lost in outline. I think I notice too a greater tendency toward an extension upward about the upper bronchial tree and toward the upper lobe than is usually found in the inflammatory lesions for, as we know, in the chronic inflammatory lesions giving rise to thickening about the hilus of the lungs, there is a tendency towards increased thickening about the lower bronchial trees as compared with the upper. Such evidence, however, in this early stage is only suggestive, and is not characteristic. As the disease progresses this area of density increases, extending toward the periphery, but extending particularly toward the upper lobe. Associated with this there is a general increase in the width and density of the mediastinal tissues. In some cases such mediastinal thickening is greatest in the upper portion just below the inner extremities of the clavicles, and at times distinct masses can be recognized in this upper mediastinum. It would seem, from

the location and general distribution and development of the disease in these cases, that it is a direct extension through the lymphatic system, just as it commonly extends through the palpable glandular system into the axilla, then into the supraclavicular region, and then into the mediastinum. Handley concludes that the vast majority of metastases are due tolymphatic permeation. It has seemed to me that in some cases I have been able to transform these lesions into dense fibrous tissue, and in a few cases the patients are still living after several years. One patient is living nine years after removal of both breasts for malignant disease, and eight years after definite mediastinal involvement. She has been treated by roentgentherapy and looks well.

3. *The Miliary Infiltration Type* (very similar to miliary tuberculosis), consisting of a fine mottling throughout the lung fields; but, as recognized also by Holmes and Ruggles, these small areas of increased density are a little larger, more dense and more sharply outlined than those of tuberculosis. This type is more difficult to diagnose, I believe, than any of the others, and it is likely that the diagnosis could not be made excepting in association with the history and careful study of the clinical symptoms. The absence of fever and the absence of other symptoms of miliary tuberculosis will easily eliminate tuberculosis in the differential diagnosis. An infiltrating syphilitic lesion of the lungs may resemble it, but can be differentiated by means of a negative Wassermann test. Infiltration of the lungs associated with leukemia also resembles this form of metastatic carcinoma, but a careful differential blood examination will eliminate the diagnosis of leukemia.

4. The fourth consists in a *progressive thickening of the pleura* associated with pleural effusion. This type is probably a direct extension of the disease from the breast into the pleura. Deaver and McFarland say that in "advanced cases the intercostal muscles often become diseased, and in some instances the pleura is involved as a result of the extension of the cancer cells through one or other of the intercostal spaces." Handley found secondary nodules on the pleura in 39 per cent of 422 cases.

It would seem from the above types that all the various theories as to the nature of the extension of metastatic carcinoma are clearly illustrated, and that all the theories are correct in certain cases.

The conclusions drawn in this paper are based upon a study of 242 cases of carcinoma in which we found positive evidence of pulmonary carcinoma in 216, negative 29, doubtful 7. This high percentage of positive findings is partially influenced by the fact that, in many instances, the examinations were made because disease was actually suspected in the chest, but it also indicates the advanced stages of the disease in which the majority of patients are referred for roentgentherapy. Of the 216 cases of carcinoma of the lungs there were

Primary carcinoma	2
Metastatic carcinoma	196
Primary sarcoma	7
Metastatic sarcoma	11

Of the cases of metastatic carcinoma of the lungs the great majority were secondary to carcinoma of the breast. I am not specifying the number because it would give a wrong impression, since all patients suffering from carcinoma have not been examined. Of the cases of metastatic carcinoma of the lungs there were

Mediastinal and hilus involvement	150
Nodular	34
Miliary	10
Pleural	12

It is evident, therefore, that the mediastinal and hilus cases are almost five times as frequent as the nodular.

The statement has been made that fat patients are more liable to early and rapid metastasis than thin patients. I therefore studied the various groups as above arranged, with the idea of determining

whether any of these groups were especially liable because of the amount of adipose tissue, also to confirm or deny, if possible, the above statement as to the relation of fat and metastasis. Of the mediastinal and hilus variety there were: fat patients, 53; medium, 65; thin, 32. Nodular variety: fat, 5; medium, 17; thin, 12. Miliary: fat, 6; medium, 4; thin, none. Pleural: fat, 4; medium, 5; thin, 3.

It would seem, therefore, (1) that thin patients are slightly more liable to the nodular variety of metastatic carcinoma, and (2) that fat and medium patients are very much more liable to metastases than the thin.

The effect of roentgentherapy on these pulmonary lesions is difficult of determination. One does not generally have the opportunity of studying these patients over a long period of time unless they are under some form of treatment. Therefore, we do not have the opportunity of comparing the progressive changes in a group of untreated cases with the changes that I can recognize in the patients who have been treated. In some of these patients treated some of the lesions seemed to have disappeared temporarily. In others, the lesions became more dense and more fibrous, resembling somewhat a fibroid phthisis. In a few instances the patients are still living several years after beginning treatment, and are apparently in good health. In most cases, however, while there is temporary improvement extending over a period of months or a year, the disease takes on a more rapid form of development with evidence of general carcinomatosis followed by death. The symptoms and roentgen findings which develop as a result of progression of the disease, most frequently involve the spinal bones, but also frequently involve the upper extremities of the humeri and the upper extremities of the femurs. The liver, in the cases I have had under treatment, has not become involved, as indicated by symptoms or enlargement, as frequently as one would suspect from the textbook statements.

In general, I believe that when the lungs are involved it must be looked upon as part of a general carcinomatosis, and with few if any exceptions one cannot expect a complete and permanent recovery.

CONCLUSIONS

1. Primary malignant disease of the lung is rare, but presents rather characteristic appearances roentgenographically.

2. Metastatic malignant disease of the lung is common, and should always be looked for in connection with advanced malignant disease.

3. A roentgen examination of the chest should be made in every case of carcinoma of the breast referred for operation or roentgenotherapy.

4. Metastatic carcinoma of the lungs may be one of four types; nodular, mediastinal with infiltration about the roots, general miliary infiltration, or pleuritic.

5. Greater attention to details in these studies will lead to earlier recognition of the disease.

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DISCUSSION

Dr. Pfahler.—I have studied 242 cases of malignant diseases, making chest examinations, and have found malignant disease in 216. This high percentage is accounted for by the fact that I did not examine all cases of malignancy that came under my attention, but only examined cases that presented some pulmonary symptoms. Therefore this percentage value means nothing. Of this series of 216 cases, or

among them, I have found different types of malignant disease, first the nodular type which was so ably described by Dr. Moore and Dr. Carman before this Society, and which excellent paper represented approximately what we knew about this subject up to that time. I can add little to their description and very little to their conclusions. I believe, however, that my experience would indicate that the mediastinal or hilus type of development of carcinoma is much more frequent, and of these 216 cases in which I found carcinoma, 150 were of the mediastinal or hilus type, while 34 were of the nodular type. Therefore you can see, from my experience at least, that there were nearly five times as many of the mediastinal type as of the nodular; but if one studies the natural progression of metastatic disease which I think pathologists recognize as being chiefly through the lymphatic system, we may expect this mediastinal or hilus development to be far in excess of the nodular. I think that the nodular type are most likely distributed as emboli and that the mediastinal are developed through the lymphatic system. The pleural group may be extended directly through the pleura; on the other hand, they may be an extension from the mediastinum to the pleura. The miliary or general infiltrating type is the least frequent, but is one that must be recognized. Briefly, any two or three of these varieties may be grouped together. In other words, you may find the lesions belonging to all three or any two in one case.

Dr. Charles A. Waters.—Dr. Pfahler has shown one very interesting case; about the fourth or fifth slide, he gave what he called sarcoma of the testicle with metastases in the lung, the lungs showing large, well-defined, consolidated areas, lobulated in shape. Last winter, at Fort Oglethorpe, we had a case of a young man whose testicle had been removed for what was supposed to be sarcoma. There was no recurrence at site of the original tumor, but six months later his lungs were filled up with large, lobulated, well defined, solid masses, identical with the slide shown by Dr. Pfahler. Since then I have seen two similar cases, both supposedly sarcoma of the testicle with metastases in the lungs. These tumors are probably chorioepithelioma and very malignant. I will refer you to an article by Dr. J. V. Cooke, of Philadelphia, who has published an excellent account of this tumor in the Johns Hopkins Hospital Bulletin of 1914, in which he reports the necropsy of a case occurring at the Pennsylvania Hospital.

Dr. Alexander B. Moore.—I wish to call attention to the study of the subject which Dr. Carman and I made several years ago. We confined ourselves to the pulmonary lesions, and we did not include the condition of the mediastinum. Since we believed that we could not draw any conclusions from such study, Dr. Pfahler's points with regard to the mediastinum are suggestive of a good field for observation.

At the time of the study we had not seen a case of the miliary type of metastasis. Recently, however, I have had one case of a patient with infiltration at the base of the upper right lobe which seemed characteristic of tuberculosis. The patient died three weeks after examination, and at necropsy a diffuse infiltration of the right lobe was found fairly well circumscribed in its extent, and malignant in character. This brings up the point that in cases in which metastasis appears as miliary deposits and later becomes confluent, a malignant and inflammatory process cannot always be differentiated in the early stages.

I would like to ask Dr. Pfahler if he is able to differentiate a simple and malignant fibrosis; personally I have been perplexed by these conditions especially in senile patients.

Dr. G. E. Pfahler.—I know pathologists have had a great deal of discussion about these testicle tumors. I think they settle down to the chorioepithelioma as the diagnosis. But some are diagnosed as chorioepithelioma and some as sarcoma. It makes very little difference to us except as to how we should classify the metastases.

The liver has in my study, as far as I could recognize by enlargement or by symptoms, been only comparatively rarely involved. The bone has been involved in about ten per cent; but we do not examine all the bones in these cases. Probably they are involved in a larger proportion of cases.

In regard to paralysis of the vocal cords, I have made no statistical record, but I remember there are only two or three cases in which there was involvement due to mediastinal pressure. Generally this infiltrating type does not do it. In one case that came to me, I was able to recognize a small nodule which pressed on the recurrent laryngeal nerve.

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CHRONIC OBSTRUCTIVE LESIONS OF THE DUODENUM

Attention has been called to chronic obstructive lesions of the duodenum from time to time by articles in the various medical journals. Recently Vanderhoof,[1] Bloodgood[2] and Kellogg[3] have discussed the clinical and surgical aspects, while Jordan,[4] Engelbach[5] and Quimby[6] have described the *x*-ray method of examination and the findings. The etiology has been described by Kellogg as follows:

"At the operating table we have learned that the obstruction may involve the first portion of the duodenum only, the first and second portions, or the entire duodenum.

"When the first portion only is dilated the junction of the first and second portions is angulated, caused by the duodenum being drawn up close to the liver by contraction of mesenteric bands or by adhesions binding together the first and second portions, or by gastroptosis, the duodenum remaining fixed. In the second group giving dilatation of the first and second portions it has appeared to be the result of adhesions extending from the gallbladder or hepatic flexure of the colon.

"In obstruction of the entire duodenum I have frequently found the condition described by Bloodgood, *i.e.*, a redundant cecum displaced into the pelvis with a short mesentery at portion of ileum near the cecum. In this group I believe the significant factor has been the dropping of the hepatic flexure which causes a straight pull of the distended bowel from the splenic flexure across the point of union of the duodenum with jejunum. The condition may exist without prolapse of the cecum, and the following causes are suggested:

"Duodenojejunal kink from prolapsed cecum and hepatic flexure; prolapse of transverse colon; adhesions from cholecystitis; ulcer; inflammation at duodenojejunal junction; constriction of opening in mesentery through which the duodenum passes; faulty development of the lower thoracic region; gastroptosis with stretching of the attachment of the second portion of duodenum; disease of pancreas.

"It is certain that frequently a con-

[1] Douglas Vanderhoof. *J. Am. M. Assn.*, Aug. 18, 1917.
[2] Bloodgood. *J. Am. M. Assn.*, 7, 13, 1912.
[3] Kellogg. *Surg., Gynec. & Obst.*, Feb., 1919.
[4] Jordan. *Brit. Med. Journal.*
[5] Engelbach. *Journal of Roent.* Volume 1. No. 1.
[6] Quimby. *Am. Jour. Electrotherap. & Radiol.*, Jan., 1919.

siderable degree of obstruction exists without symptoms, the condition being found at operation or by x-ray examination."

The clinical picture as drawn by Vanderhoof is as follows:

"(1) Persistent or recurring vomiting. In most instances the vomitus contains bile, often in a considerable quantity.

"(2) Pain in the upper part of the abdomen, generally referred to the right hypochondrium. As a rule, this is described as an aching or dragging pain, but it may be severe, so as to suggest biliary colic, or in other instances, it simulates the pain of peptic ulcer with irregular food relief. (It frequently closely imitates appendicitis or renal colic.)

"(3) 'Habitus enteroptoticus' often associated with exaggerated lordosis.

"(4) Obstinate constipation is the rule, although this may not be a feature of the case. Occasionally the stools are colorless and relatively free from bile.

"(5) Vague toxic symptoms, headaches, neuralgia, etc."

The most important of the roentgenological findings are:

1. Marked retention in the duodenum for which no other cause can be given. This is commonly known as puddling.

2. Writhing and twisting of the duodenum.

3. Reversed peristalsis.

4. Tenderness over the angle of Trietz.

5. Dilatation of the duodenum.

The first four of these signs may be found in the course of the ordinary gastric examination, and while the fifth may be so observed, a special technique is usually required which is described by Engelbach as follows:

"With the patient before the vertical fluoroscope, after the aqueous solution of barium is given, and before the second buttermilk meal of barium is taken, the terminal portion of the duodenum the location of which has been determined by watching the barium pass through it, is constricted by pressure of the left hand against it and the body of the vertebra. The remainder of the duodenum is then filled with barium by grasping with the right hand the antrum and pyloric end of the stomach and milking its contents into the duodenum."

The appearance of the dilated duodenum is rather striking in that it is so very large in comparison to the normal, and the markings of the valvulæ canniventes are conspicuously absent or nearly so.

Just why this condition has not received the attention its seriousness merits by x-ray workers is difficult to explain. Perhaps the rather limited use of the fluoroscopic screen may account for it.

The fact remains that many of our patients have been labeled neurasthenics or indeterminates by our incomplete examinations, whereas the method offers a diagnosis in most if not all of these lesions.

NOTICE OF MEETING

The Middle Section of the American Roentgen Ray Society will hold its meeting at the Congress Hotel in Chicago on Saturday, February 21. The forenoon will be occupied by speakers from Chicago. The afternoon program will consist of papers by those attending, and in the evening there will be an informal demonstration of lantern slides from interesting cases. A dinner will be served between the afternoon and evening sessions. All those who can offer papers or demonstrate slides will communicate with Dr. A. F. Tyler, 507 City National Bank Building, Omaha, Nebraska.

TRANSLATIONS & ABSTRACTS

Zeno, L. O. Chronic Intestinal Stasis. (*Rev. méd. del Rosario*, May, 1919, Vol. 9, No. 2, p. 118. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 236.)

Zeno has been working with Lane in England and describes with numerous illustrations Lane's theories in regard to chronic intestinal stasis and its causes. He criticizes Lane's ideas, and presents arguments to the effect that the avascular bands are found in the majority of persons, and have no pathologic significance. The same is true of the vascular membrane, Jackson's membrane. This represents relics of the direct prolongation of the great omentum in fetal existence. In studying these bands and membranes we must not be misled by the multiplicity of names that have been conferred on them. The surgeon in particular should familiarize himself with the various aspects which these normal formations may assume. Zeno found the so-called duodenojejunal band in 60 per cent of forty child cadavers, the ages ranging from 2 months to 10 years. He also noted that when the bismuth suspension reached the point of the angulation it seemed to slip through the kink as readily as through the wide lumen above. The bands do not always occur at points where they can by any possibility serve as supports, while they may be conspicuous by their absence at other points where they would certainly develop if Lane's theory were sound.

Lumière, A. Accessory Focal Spots for Rays Discharged by Tubes Used in Radiology. (*J. de radiol. et d'électrol.*, Par. May, 1919, Vol. 3, No. 5, p. 193. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 231.)

Lumière cites those who have been making a study of the accessory sources of the roentgen rays, and then describes similar research undertaken with the tubes as usually employed in radiology and also with all the sources of the principal or parasite rays discharged by the apparatus producing the roentgen rays. Some of the radiograms were taken with the tube turned completely around, the exposure made through the thin plate of the anticathode, directly opposite to the usual direction of the rays. The roentgenogram was as perfect (with the Muller tube) as when the routine conditions had been exceptionally favorable.

Guilleminot, H. Comparative Tests of Roentgen Tubes. (*J. de radiol. et d'électrol.*, Par. May, 1919, Vol. III, No. 5, p. 193. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 295.)

Guilleminot describes how to compare the sharpness of the images, the total output of rays per current, and the endurance of the tubes. The fluorometer is the main reliance in the tests.

Ortiz, Ruben Vila. Serotherapy. (*Rev. méd. del Rosario*, May, 1919, Vol. IX, No. 2, p. 118. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 166.)

Ortiz protests against the custom in Argentina of dispensing antiserums in such small doses that fifty-six vials had to be used, for instance, in one case of tetanus, to give 84,000 units of antiserum. The small number of units per vial renders treatment unnecessarily expensive. He urges that ampules should be available containing 100 c.c. of the antiserum.

Eiken, T. Roentgen Therapy of Cancer. (*Hospitalstidende*, Copenhagen, May 21, 1919, Vol. LXII, No. 21, p. 641. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 236.)

Eiken reports from Rovsing's private clinic the complete cure of a woman of 46 who in the course of fifteen months had had a mammary carcinoma removed and also two recurrences at its site, and during the last six months had been having pains in the femur on that side, and a large metastatic tumor developed here. This tumor subsided completely under vigorous roentgen treatment. The pains were relieved after the first application (30 H. through 6 mm. aluminum), and by the end of the month she could take a few steps without support. The results were as complete as with excision of the focus, but this treatment, as too often happens, was not applied until the malignant

disease had invaded practically the whole body, and the patient succumbed to metastasis elsewhere. In another case a large mammary cancer subsided to a clinical cure under one exposure (50 H. 8 mm. aluminum, ninety minutes) with a second exposure after a month's interval. All his other patients succumbed sooner or later to metastases probably already installed.

Shittenhelm, A. Roentgen Diagnosis with the Aid of Artificial Gas Accumulation in the Abdominal Cavity (Ueber Roentgendiagnostik mit Hilfe Künstlicher Gasansammlung in der Baudehöhle). (*Deutsche med. Wchnschr.*, Berl., 1919, XLV, No. 21, 566.)

Two methods are in use. 1. Contrast effects are produced by gaseous expansion of the stomach and intestines. The intestine is filled with gas by means of a rectal rubber tube and the stomach by means of a stomach tube. This method gives usually a clear picture of the position, form and size of the liver, spleen and frequently also of the gallbladder as well as of certain tumors. When the results are not satisfactory the following method is used: 2. The peritoneal cavity is filled with oxygen. The procedure is quite simple in patients with ascites, but patients without ascites present rarely any difficulty. A syringe provided with a fine cannula and filled with a physiological salt solution is cautiously forced through the abdominal covering, the finger resting on the piston of the syringe. The easy flow of the liquid shows that the needle has reached the abdominal cavity. The oxygen is introduced by means of an insufflation apparatus such as is used in pneumothorax therapy. About 2 liters of oxygen are usually sufficient. The patient is examined first lying down and then standing. On rising, the patient frequently experiences pain due to adhesions especially of the liver. By this method the liver, and especially the spleen when enlarged, are well outlined. The gallbladder, however, is not always seen.

Keppler, W. and Erkes, F. Roentgen Diagnosis in Diverticula of the Esophagus (Zur Roentgendiagnose der Speiseröhre). (*Med. Klin.*, Berl. & Wien, 1919, XV, No. 20, 480.)

During the past year the authors observed two cases of esophageal disease in which the roentgen plates clearly pointed to a diverticulum, but when the operation was performed it was found that the pathological process was a cancer. The authors then looked up the literature and found that in 250 cases reported the roentgen diagnosis had erred in 3.6% (including the two cases mentioned here). While this result does not lessen the value of the roentgen rays it is well to remember that in stricture processes of the esophagus of various etiology the *x*-ray may present an appearance which cannot be differentiated from a genuine diverticulum.

Pollitzer, H. Asthma-like Symptoms Due to Roentgen Rays in Leukæmia and to the Effects of Vaccines in Typhoid Fever and the Pathogenesis of These Symptoms (Ueber Asthmaartige als Roentgenwirkung bei Leukämie und als Vaccinewirkung bei Abdominal Typhen und die Pathogenese dieser Erscheinungen). (*Med. Klin.*, Berlin, 1919, XV, No. 19, 457.)

In exposing the spleen to the *x*-rays in the treatment of leukæmia sometimes a temporary bronchitis with eosinophilia and relative difficulty of breathing is noticed. Difficult breathing and marked expansion of the lungs is also observed in vaccine treatment of typhoid fever. Both syndromes seem to be due to the pathogenetic effects of vaccination with a foreign protein, in the one case of the bacteria, in the other of the dying leukocytes. The syndrome in leukæmia seems thus to form a bridge to bronchial asthma.

Rautenberg, E. Pneumoperitoneal Roentgen Diagnosis of the Kidneys. (*Berl. Klin. Wchnschr.*, 1919, LVI, No. 9, 201.)

The method is so simple that the author does not use special instruments. A fine cannula and double bellows are sufficient to fill the peritoneal cavity with air. The kidney is best seen when the patient lies on his side, as the convolutions of the small intestine sink down by gravity. The field of vision is limited below by the spinal column, and the kidney lies free behind the air-filled portion of the abdominal cavity. Sometimes, however, the upper portion of the right kidney is covered by the liver, but

even then the outline of the kidney can be followed. Such a picture is of great importance, for by the usual methods the kidney can never be seen clearly and its form and size are quite indistinct. To judge of the size and changes of form of the kidney it is advisable to keep always the same focal distance (60 cm.). Displacements of the kidney are clearly shown by this method. The diagnostic procedure described forms an important aid to functional diagnosis. At the close the author discusses several practical cases of renal tumors and kidney stones.

Burchard, A. The Roentgenological Demonstration of the Muscle Changes Produced by the Various Anaërobes Found in Gaseous Edema (Ueber den röntgenologischen Nachweis der durch die verschiedenen, beim Gasödem gefundenen Anaërobier hervorgerufenen Muskelveränderungen). (*Fortschritte a. d. Geb. d. Röntgenstrahlen*, Hamb., 1919, XXVI, No. 3, 260–270.)

The author reports 9 cases of wounded soldiers in whom gaseous edema and gaseous gangrene developed. The roentgen examination showed that two different forms of muscle changes take place. In one form the roentgenogram shows a spotted and layer-like arrangement of the gaseous accumulations, in the other the muscle fibers are completely filled with extremely fine gas bubbles but the muscle structure is clearly distinguishable. The first form occurs only in cases of infection with the Fränkel bacillus, the second form was observed in infections with the bacillus butyricus (Aschoff) sometimes associated with the bacillus putrificus.

The roentgen diagnosis in gaseous edema is very important. The processes in the muscle which are usually only recognized at the operation or post mortem, are early shown in the roentgen plate, which thus furnishes important data as to prognosis and treatment.

Strauss, O. Roentgentherapy and the Problem of Cancer Treatment. (*Fortschr. a. d. Geb. d. Röntgenstrahlen*, Hamb., 1919, XXVI, No. 3, 232–244.)

Early *x*-ray treatment of cancer is of great importance, but there is no means of establishing an early diagnosis; even a fully developed cancer is sometimes difficult to diagnose. Two effects of cancer are harmful: the atypical catabolism of the albuminoids and the diminution of the oxidative processes in the body. Cancer consumes not only its own albumin but also that of the organs. The heterolytic ferment of cancer gets at a later stage into the circulation and we have the clinical picture of cachexia. The cachectic organism is much less sensitive to the *x*-ray than the non-cachectic. Carcinoma of the cervix uteri is diagnosed much earlier than any other form of cancer and this explains the favorable results of the *x*-rays in cervical carcinoma. Except in cervical cancer roentgentherapy of carcinoma is not superior to surgical treatment. The best results are obtained by a combination of both methods. Statistics show that the application of the roentgen rays in operated cancer cases has increased the permanent cures by 30 per cent. Roentgen treatment plays also an important rôle in inoperable cancer.

Clark, John G. The Treatment of Myoma Uteri with Radium. (*J. Am. M. Assn.*, Vol. LXXIII, Sept. 27, 1919, p. 957.)

As a result of observations made in over 150 cases, it may be positively stated that from the standpoint of efficiency, safety and morbidity radium must supplant surgery in the treatment of uterine myomata and intractable myopathic hemorrhage, within certain limitations. Beyond these limitations surgery is indicated in properly selected cases. When radium is not available the use of the roentgen ray may be used as a substitute, in skillful hands. Only gradually and to a limited extent has radium been used prior to the menopausal cycle. It may be as potent in bringing on a menopause as oöphorectomy. Fifty mg. in the uterus of a young woman for 24 hours will do this.

There are three essentials in treatment: accurate diagnosis, proper selection of cases and careful gradation of dosage, especially in young women. Experience has brought out certain prominent facts governing treatment: (1) The tumor must be uncomplicated by inflammatory disease, and never treated if so complicated. A flare-up of a quiescent salpingitis or other inflammatory condition is likely to be induced. (2) The growth must be

causing hemorrhage. (3) It must not be too large. The extreme limit is a five months' pregnancy, and the size of a three months' pregnancy is a much safer limit, except where there are contra-indications to operation. The larger growths are more likely to have associated lesions or may be pure fibroid, dense hyaline or calcareous types, not responsive to radiation. (4) Pain is not as a rule relieved, especially in inflammatory disease, and cases with pain lateral to the uterus are not radiated. Moreover, operation offers the opportunity to ascertain the extent of additional pathology. (5) Malignant and benign degenerations contra-indicate the use of radium. One frequently finds a degree of anemia, a cachectic appearance or a toxic asthenia not accounted for by the amount of hemorrhage. This may be due to malignant degeneration, but more often to benign degeneration, the absorption from which causes the general condition. Hysterectomy is quickly followed by a return to normal, but radium only makes matters worse by hastening the degenerative process.

The possibility of sarcoma being present need hardly be considered. Out of 816 myomas examined in the laboratory, only 26 showed sarcoma.

Symptoms accompanying radiation: Nausea is frequently observed, either at once or 24 to 48 hours after the application. The routine administration of morphin may be partly or wholly responsible for this in many instances. Pain is a variable symptom, and may be due to the routine curettage for diagnostic purposes. If persistent or accompanied by fever, an acute inflammatory attack or exacerbation of a quiescent process is to be suspected. It is proposed to avoid this risk by omitting curettage in cases with periodic menorrhagia following the menstrual type without intermenstrual spotting. This would exclude the possibility of a fundus carcinoma, but when intermenstrual spotting or continuous bleeding are present, curettage is essential. Cancer of the fundus requires hysterectomy. Leucorrhea usually follows for 3 to 6 weeks, but is not profuse. Hemorrhage usually ceases at once, but not always. The menopause is variable. In marked anemia, the change is more abrupt and with more pronounced symptoms. This may be due to the sudden check in the activity of the hematogenous system due to the stoppage of bleeding. Patients as a rule do not object to the artificial menopause so produced.

Technic: Under gas anesthesia, the cervix is dilated and a simple curettage is performed for diagnostic purposes. This is followed by light packing of the uterine cavity with 5 per cent solution of iodin momentarily before the radium is introduced. Fifty mg. radium in a platinum or silver capsule enclosed in a black rubber tube tied at both ends is then introduced into the fundal cavity to the top. If the cavity is three and one half inches or more in depth, two tubes of 25 mg. each, are used tandem. In women in the menopausal years, this is allowed to remain 24 hours. Under the age of 40, the dose is graded according to years. If 35 to 40, the application lasts 12 hours, and if younger, 6 hours, making a reapplication if necessary. In this way the menopause is likely to be avoided. After withdrawal of the radium, the patient is kept in bed three days, and discharged at the end of five days, and permitted to resume her usual duties. As a rule the menopause is permanent when induced, but periods may return.

Results: In six cases failure of satisfactory relief required subsequent hysterectomy.

H. K. Pancoast.

Bumpus, H. C. Diverticula of the Posterior Urethra. (*Surg., Gynec. and Obst.*, October, 1919, Vol. XXIX, No. 4.)

The repeated finding of diverticula of the posterior urethra during routine cystoscopic examination led to a search through the records of the section of Urology of the Mayo Clinic. The literature as reviewed by Ehrlich revealed but 70 cases of urethral diverticula up to 1908. Watts reported one case and reviewed the literature in 1906 and Englander added two cases in 1917. In the cases at the Mayo Clinic the diverticula were all confined to the posterior urethra; their clinical histories vary considerably from those reported in the literature.

Watts, besides his complete and thorough review of the literature, gave an excellent classification of urethral diverticula, as follows.

A. Congenital diverticula
B. Acquired diverticula
   1. From dilatation of urethra resulting from

a. Calculus
b. Stricture
2. With perforation of the urethra resulting from
a. Injuries to the urethra
b. Rupture of abscess into the urethra
c. Rupture of cysts into the urethra.

A differentiation is also made between true and false diverticula. The former is a dilatation of the normal urethra with a mucous membrane lining identical with that part of the urethra from which it arises. The latter is the result of urethral rupture and, therefore, has a lining of epithelium or fibrous tissue according to the extent of repair that has occurred. Of the true diverticula the congenital offers the most perfect type. It occurs in the anterior urethra and is probably the result of a failure of the urethral floor to close during fetal life, a condition similar to that of hypospadias, or, as Watts suggests, a condition due to congenital stricture or phimosis.

Diverticula of the posterior urethra are probably always of the acquired type and usually of a traumatic origin. Surgical procedures about the perineum either for the drainage of the seminal vesicles or for the removal of bladder or prostatic stones, are probably the most frequent factors in their formation. Frequently falling astride some hard object with resulting rupture of the urethra, or the formation of a hematoma with secondary rupture into the urethra, results in their formation. Strictures are also an etiologic factor, both because of their tendency to cause dilatation posteriorly and because of the inaccurate passage of sounds in an attempt to dilate with resulting false passage and urethral rupture. Abscess formations in the neighborhood of the posterior urethra or in the seminal vesicles, with secondary rupture and drainage into the urethra are frequently the origin of diverticula.

In cases in the literature a tumor at some point along the urethra is an almost constant finding, and the history of being able, by digital pressure, to expel varying amounts of urine from such a mass is considered very suggestive. Diverticula may develop and yet give no physical signs; they even burrow under the bladder until they nearly equal it in size and capacity. Lane reported several cases similar in character, found at necropsy.

Diverticula of the posterior urethra give a series of symptoms:

1. Dribbling or complete incontinence, depending on how near the diverticula is to the external sphincter.

2. Dysuria resulting from the passage of urine through a constantly inflamed and irritated posterior urethra; this is often accompanied by tenesmus.

3. The presence in the perineum of a pocket filled with infected residual urine causing a constant feeling of discomfort often described as "resembling a ball of fire" which compels frequent urination in an effort to relieve the condition.

That such diverticula may be overlooked is easily understood if it is realized that the condition is often associated with a normal bladder.

CONCLUSIONS

1. Diverticula of the posterior urethra are generally of the acquired type.

2. Probably the most frequent etiological factor is a previous perineal operation.

3. They give rise to a definite syndrome, namely, incontinence, dysuria, interrupted micturition, perineal pain, and pyuria.

4. The absence of perineal tumor is not incompatible with their presence.

5. Since they may be associated with a normal bladder they may easily be overlooked unless the posterior urethra is carefully examined.

W. W. Belden.

Clark, S. M. D. Use of Radium in Fifty Cases of Uterine Hemorrhage from other Causes than Carcinoma or Myomas. (*J. Am. M. Assn.*, Vol. LXXIII, p. 952, September 27, 1919.)

The cases are divided into three groups:

1. Young women with excessive bleeding without marked discomfort but with constitutional impairment from loss of blood, with or without any anatomical defects. In such cases the usual measures fail and radical operation is the only procedure left, except radium. As radium acts by altering the endometrium and myometrium rather than by alteration of ovarian function, it is distinctly

indicated. A satisfactory result may be obtained without complete suppression of menstruation, but if the latter is necessary it is preferable to an abdominal operation. In one case out of five, one application 750 mg. hours relieved symptoms without stopping menstruation. In four others, treatment varied from 1275 mg. hours, two applications, to 3859 mg. hours, four applications, in all of which there was complete cessation of menstruation.

2. Aggravated and intractable cases of dysmenorrhea which have resisted all treatment, and with general health impaired. Usually neurotic type, advancing in years and unmarried. Patients have about ten comfortable days in a month. There may or may not be anatomic wrong. Menstruation must be stopped. Radium will produce the desired effect with less pain and discomfort than an operation and is not followed by as intense nerve disturbances. In one case out of twelve radium relieved pain and normal menstruation followed, while in the other eleven complete relief followed chiefly through suppression. In the one case one application was given of 50 mg., 525 mg. hours. In the other cases two to six applications were made, usually with 50 or 75 mg., and the total exposures varied from 1250 to 3000 mg. hours.

3. The greatest number of cases are those coming under the classification of "chronic endometritis." The exact pathological condition may be polypoid, hypertrophic or hyperplastic endometritis, or result from myopathic or vascular changes. Patients are usually between the ages of 36 to 56 years, many have borne children, the uterus usually is in malposition, is enlarged and firmer than normal, and there is an associated cervicitis. All other methods of treatment aside from hysterectomy and radium have failed. Inflammatory disease and malignancy must first be excluded. It is the rule in radium treatment that menstruation must be suppressed, but the nerve disturbance is less than with operation, and there is less discomfort and less danger to life. Such uteri have completed their functional periods. Thirty-five cases of this kind are reported, with one partial failure. On account of continued bleeding, hysterectomy was performed because of the potential danger of malignancy. In this case three applications of radium were made, using 50 to 100 mg., and the total dosage was 2250 mg. hours. In the others, the shortest treatment was one application 50 mg. for ten hours. Several others were nearly as short. Others required from two to four or even six applications, with usually 50 to 75 mg. of radium, and the dosage varied from 1000 to a maximum of 3450 mg. hours.

H. K. PANCOAST.

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A ROENTGENOLOGIC STUDY OF METASTATIC MALIGNANCY OF THE BONES *

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ROCHESTER, MINN.

PFAHLER, in his excellent paper presented before this Society in 1916, called attention to the characteristic roentgen appearance of metastatic carcinoma of the bone, and impressed on us the necessity of a thorough *x*-ray examination in all cases of known or suspected malignancy in which there is any suspicion of a secondary involvement in the osseous system. My object in this paper is further to emphasize this necessity and to give a summary of the combined clinical and roentgen findings in 65 such cases that have been seen in the Mayo Clinic.

Fraenkel, von Recklinghausen, and others, have described two types of secondary bone metastases, the osteoclastic and the osteoplastic. The osteoclastic form is characterized by marked lacunar absorption and destruction of bone causing an extreme porosis of the osseous tissue. The osteoplastic form is characterized also by lacunar absorption, but there is a marked thickening of the bone due to the collection of the malignant cells, and from a secondary calcification around the malignant process. According to these observers the two types occur simultaneously; this is substantiated by the roentgenologic evidence, the two being found quite frequently in the same bone.

The osteoclastic form is characterized in the roentgenogram by an extreme decrease in density, the bone having a honeycombed appearance that is typical.

The osteoplastic form is characterized in the roentgenogram by an irregular increase in bone density, the bones having a chalky appearance without cortical or periosteal thickening. Our observations agree with those of Pfahler, who states that the osteoplastic form is most common in cases of carcinoma of the prostate, while the osteoclastic is most common as a secondary manifestation of breast malignancy. Authorities on the subject differ as to the route of extension. Handley doubts the extension by the blood stream and believes that the malignant cells metastasize entirely by way of the lymphatics. Risley, from his own studies and a review of the literature, concludes that the metastasis occurs by either the blood or by the lymph stream.

The number of cases in our series in which there was no demonstrable involve-

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ment of either the deep or superficial lymph glands seems to show that the metastasis occurs quite frequently by way of the blood. Von Recklinghausen states that the bone is primarily involved in its marrow and that the cortex is involved through the foramen.

Mathews believes that the most common sources of bone metastasis are the breast, thyroid, prostate, and kidney. In the present series the primary growth was situated as follows:

	Cases
Breast	36
Prostate	11
Kidney	7
Thyroid	2
Vulva	1
Sigmoid	1
Uterus	1
Abdominal masses of unknown nature	3
Primary source not discovered	3

65

Carcinoma of the breast is unquestionably the most common primary source of bone metastasis, but if one considers the high percentage of carcinomas that are located in the breast, the height of this percentage will be materially reduced.

There seems to be a wide disparity between our statistics and those quoted in the literature in which carcinoma of the thyroid is regarded as being second only to carcinoma of the breast as a source of bone metastasis. As I have stated, we have in this series but two cases of bone metastasis originating in the thyroid gland, although we have seen several hundred malignant conditions of the thyroid, a high percentage of which were examined by the roentgen ray. This difference may be explained by Crotti's statement that malignant adenomas of the thyroid are very prone to give rise to bone metastasis, while they are very rare in cases of scirrhous cancer of the thyroid. The high percentage of metastases that are secondary to malignancy of the breast and prostate is probably due to the blood and lymph supply, and to the fact that the neoplasms are usually slow-growing types.

In all probability the extreme rareness of bone metastasis in cases of cancer of the stomach is due to the fact that malignant conditions of the stomach speedily produce death unless immediate treatment is given. In 1600 patients with cancer of the stomach who have been examined at the Mayo Clinic during the last ten years, no bone secondaries have been found. Of the 7 cases of bone metastasis secondary to tumors of the kidney, 6 followed hypernephromas, and one followed a so-called neurocytoma, a tumor originating in the sympathetic nerves in the adrenal. The case was that of a boy aged thirteen who had metastasis in the skull and sternum with a fatal termination within six months after the condition was discovered. In our experience the bony metastasis of all types of malignancy gives the same roentgen appearance, thus emphasizing the fallacy of attempting a cellular diagnosis by the roentgenogram. The metastases in the present series were as follows:

	Cases
Spine	22
Pelvis	11
Femur	9
Ribs	6
Humerus	6
Clavicle	1
Sternum	1
Radius	3
Skull	3
Tibia	2
Bones of hand	1

Risley states that metastases are rare below the elbow and knee, and explains this by the fact that death usually occurs before the process extends. However, in our series, there were 6 cases; 3 in the radius, 2 in the tibia, and 1 in the bones of the hand, in which there was extensive involvement.

As Pfahler has noted, the spine is the most common site of bone metastases, and any vertebra from the atlas to the sacrum

may be involved. In the 22 cases in our series showing spinal involvement more than one vertebra were involved in all and the process was located in the lumbar region in 75 per cent.

A review of the clinical histories of these cases shows that the average age of the patients was fifty years; 42 were females, and 23 were males; the average time that had elapsed since the primary growth was discovered was two and one-half years, the extremes being nine years in one case and six months in another. The most common symptom was pain, this being noted in 57 per cent of the cases. The pain is rather characteristic and resembles that of neuritis; it is almost always constant and is referred along the course of the nerve trunks. The pain is always increased by motion, but the degree of the increase is in direct proportion to the proximity of a joint to the area involved. It has been remarkable that in spite of extensive areas of involvement, the patient was able to move without apparent inconvenience: this is especially true in cases with metastases into the pelvic bones. While in cases of known or suspected malignancy the presence of pain should always be an indication for a thorough roentgen examination, it must be remembered that pain of a similar nature is a fairly common complaint of many patients over fifty years of age; this is particularly true in cases of extensive malignancy when pressure, either from the primary growth or enlarged glands secondary to it, may produce pain. It should also be borne in mind that malignant metastasis to the spinal cord is not uncommon, and that this produces pain similar to that caused by bone metastasis. Superficial swelling is uncommon in cases with bone metastasis, but in cases in which there is metastasis in the long bones or in the skull irregularities may be discovered by careful palpation. As Boggs says, spontaneous fracture is a fairly common occurrence in cases of bone metastasis and may be the first index of its presence. Spontaneous fractures occurred in 6 of our 65 cases, and in 2 there had been no previous indication of malignancy. One of the spontaneous fractures, located in the middle third of the humerus, united without delay. Our statistics seem to show that pulmonary and bone metastasis rarely occur together; in but 3 of our cases was there any evidence of involvement in the lungs.

As I have stated, the roentgen appearance of bone metastasis is quite characteristic, and in most cases an unqualified diagnosis may be made. Of course in this, as in all conditions, the roentgen evidence must be corroborated by careful clinical history-taking and examination. The cases presenting the most difficulty are those of suspected spinal involvement in which careful technic must be employed and satisfactory plates obtained before a diagnosis can be made. Lateral roentgenograms, as described by Hickey, have proved a great aid in the examination of these cases.

CONCLUSIONS

1. Bone metastases may result from malignancy of almost any organ, but the most common foci are the breast and prostate.

2. Bone metastases are uncommon in malignancy of the thyroid.

3. Bone and pulmonary metastases are rarely associated.

4. The most common symptom complained of is pain, which is fairly typical and should be regarded as an indication for a roentgen examination.

5. The roentgen appearance is characteristic, and a thorough examination should be made by the *x*-ray in all cases in which there is any suspicion of bone metastasis.

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DISCUSSION

Dr. Geo. E. Pfahler.—I have been very much interested in this subject and I appreciate the further study that has been made by Dr. Moore. There is one point on which I probably would not agree with him, and that is the rarity of lung involvement in connection with the involvement of the bones. I have not looked up the statistics, but I have just run through this subject, and I will present the lung side a little later; but I am sure that at least ten per cent of the cases I studied had bone involvement. We would probably find a great deal more of bone involvement if we studied these cases more and studied the bones thoroughly. We are apt to confine our studies of bones to cases that complain of pain. Generally speaking that has been my practice, because it is quite a job to go over the bones of the entire body unless you are paid for it.

I would also like to emphasize what he has said, that very frequently or generally the patients die of the disease before it has reached the bones; and if we could keep the patient alive longer, we would be apt to get more bone involvement, which probably accounts for the fact that I found a larger percentage. In other words, I treated these cases and kept them from local recurrences, and that is the reason I find these bone involvements.

The second point I would like to emphasize is the great tendency to involvement of the lumbar spine and the iliac bones in the neighborhood of the sacro-iliac joint, accounting for these sciatic pains, as the patients describe them. They all complain of sciatica or of rheumatism of the hip, and we generally find an involvement of the upper portion of the ilium at the upper extremity of the sacro-iliac joint. I think also that we find the more frequent association of this with breast cases because we have more breast cases to deal with.

Dr. William H. Stewart.—I am especially interested in Doctor Moore's subject, believing that bone metastases take on much the same histological changes as the primary growth, i.e., where the original tumor was a soft medullary growth the bone metastasis appears as the osteoclastic form, while, if the primary cancer was scirrhous, the secondary bone manifestations would be of the osteoplastic form. This is a rather broad statement but so strongly do I feel the correctness of this observation that I frequently venture to diagnose the character of the primary growth by the appearance of the secondary manifestations. Especially does this apply to the osteoplastic form following carcinoma of the prostate and the osteoclastic form following carcinoma of the breast.

I trust Doctor Moore will support me in these observations.

Dr. L. T. LeWald.—I understood Dr. Moore to say that it was futile to attempt to distinguish the type of primary growth by the type of secondary growth, and that has been my experience—that the secondary growths from different types of tumors may look alike. I have seen a number of instances of that sort. I showed some of these last year at the meeting, and exception was taken on the ground that they were unusual cases; but I think Dr. Moore's series would back up that statement, that it is futile to attempt to distinguish the histological type of tumor by its gross manifestations in the bone.

Dr. David R. Bowen.—I would like to ask Dr. Moore whether he finds relationship between the metastases and the area involved—whether malignancy of the prostate is likely to involve the adjacent skeleton, as the lower ilium, rather than the more remote bony structures.

Dr. C. F. Ball.—I would like to ask Dr. Moore whether the age at which metastasis occurs indicates anything as to severity of bony lesion as does age to the appearance of the primary lesion. I had a patient thirty-two years of age in whom the amount of pain she complained of following her breast amputation and postoperative *x*-ray irradiation was very slight. However, one day when coming to the office

for treatment for a nodule which had developed in her scar, she fell when attempting to step up from the street to the curb. Her fall was due to the head of the femur puncturing through the acetabulum as was later shown by *x*-ray examination. The whole ilium and the shaft of the femur were simply honeycombed, the principal process being not near the sacrum but around the acetabulum. She was not complaining of pain that required any definite attention or that required morphine. She had not complained of pain in the back or hip. This extensive process had developed with but few observed manifestations and these of so slight a nature as to have been practically overlooked until time of fracture. Beware of ***suggestive*** bone pains in malignant patients.

Dr. A. L. Gray.—In regard to what determines whether we have an osteoplastic or osteoclastic type of metastasis, it seems to me the thing that determines it is the type of the primary tumor and whether it is of rapid malignancy or is slow growing. I don't know whether Dr. Stewart means to confine the osteoplastic type to the prostate, but I am quite sure I have seen both kinds in the female and have usually attributed the difference to the type of primary tumor, whether it was of rapidly growing malignancy or whether it was one which allowed the bone sufficient time to repair in its imperfect way, producing osteosclerosis or hyperplasia of the bone.

Dr. A. B. Moore.—With regard to Dr. Pfahler's question about the intercurrence of metastases in the lungs and in the bones: I am not willing to disagree with him. I believe that Dr. Bissell stated that nothing lies like statistics. During the past three years I have been interested in metastasis in the lungs, and in a high percentage of these cases I have tried to make an examination of the long bones. Many of these patients are, however, too sick to be submitted to examination, so that my findings are based only on partial statistics.

I am not able to answer Dr. Hickey's question as to whether or not any idea of the type of the primary growth may be gained from the type of bone metastasis.

I emphatically agree with Dr. Stewart that a case of osteoplastic metastasis may rightly be called "secondary to the prostate" in the majority of cases. Whether there is a reason for this I do not know. Certainly osteoplastic metastasis is not always due to carcinoma of the prostate, nor is it the only type which may be associated with carcinoma of the prostate. However, it is the most frequent type that I have seen. In cases of carcinoma of the breast I have observed osteoplastic and osteoclastic types of metastasis in the same bone. When the bone is sectioned by the pathologist honeycombing is found, and in areas in which the process is localized there is a secondary thickening and calcification. Osteoplastic metastasis might be expected to be a type associated with slow growing conditions in which the patient has a certain immunity, but this is merely speculation.

In regard to Dr. Bissell's question as to the site of the primary lesion: In the osteoplastic type the prostate may always be suspected, and in young persons the tumors around the kidneys are the most common site for the metastases. In fact, in children with irregularities of the skull, and emaciation, the first thing to be suspected is kidney tumor.

I agree with Dr. Boggs' statement that scirrhous carcinoma of the breast is the most common type of breast cancer which produces bone metastases. A certain type of case that we all see, is that in which the blood picture indicates a pernicious anemia, but the other findings are not typical of the condition. Harrington states that these patients are very often suffering from a malignant condition with bone metastases.

MYXOMA OF BONE WITH REPORT OF A CASE OF MYXOCHONDRO-SARCOMA OF THE FEMUR*

BY ALBERTUS COTTON, M.D. AND STANDISH MCCLEARY, M.D.

BALTIMORE, MD.

At the New York meeting of the American Roentgen Ray Society in September, 1917, in collaboration with Dr. Standish McCleary, I reported a case of myxoma of the femur. This report appeared later in Vol. V, No. 2 and No. 4 of the JOURNAL. On account of the great destruction of the limb in this case it was necessary to amputate at the hip joint. After careful examination of the entire amputated femur and thigh, the report of the pathologist was pure myxoma. This patient lived comfortably for a period of two years, during which time she gained flesh and enjoyed good health. She had some pain in the stump of the amputated limb during this time but not sufficient to require anodynes. A little more than two years after the operation, the patient developed a mass in the lower abdomen just above the groin on the right side, which caused her severe pain in the lower abdomen and stump of the amputated limb. At about the same time the patient developed a cough which persisted to the time of her death. There was no hemorrhage from the lungs and the patient did not have dyspnea. There was a gradual loss of strength and flesh until the patient died in April, 1919, two and a half years after amputation. The tumor mass did not break down or ulcerate and no section was obtained for pathological examination. The report sent would indicate that the patient died from a recurrent sarcoma.

I now wish to report another case of medullary tumor of the femur which was diagnosed by gross and microscopic examination made at the time of the exploratory operation as myxochondroma. A conservative operation was done consisting of chiseling and curetting the affected area of the femur. The patient recovered from this operation and was able to attend to his business when a recurrence was noted. Amputation at the hip joint was done. Examination of the amputated specimen showed the tumor to be a myxochondrosarcoma of the femur. The patient now has metastasis in the lungs and a recurrence in the stump.

The following is the report of this case: C. W., aged forty-five, reported for examination and treatment in May, 1918.

Family History.—Negative.

Previous History.—Patient had injury to left shoulder and hip five years previously. No immediate after-effects were noted from this injury.

History of the Present Condition.—Two years previously the patient began to have pain in lower back, left buttock and thigh. During the past year the pain had been worse in the thigh. The patient had consulted a dozen or more physicians and was treated for rheumatism, neuritis and various other conditions without relief.

Physical Examination.—There were no physical signs of sacro-iliac trouble. The hip joint movements were normal on both sides. Some tenderness was noted over the upper three-fourths of the shaft of the left femur. There was no muscle atrophy, no tumor showing, and no difference in measurements of limbs at this time. The general condition of the patient was good.

X-ray Examination.—Plates were made of the lower lumbar spine, pelvis, right and left hips and femurs. The lumbar spine, pelvis and right hip and femur plates were negative. The plate of the left hip-joint and upper third of the femur showed an enlargement of the shaft of the femur from just below the great trochanter

*Read before the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3–6, 1919.

to the middle of the shaft. The enlargement was produced by the bulging outward of the cortical bone. There was irregularity of outline of the cortex throughout this area and thinning at the upper part just below the trochanter major. The rest of the cortex in this area was of normal thickness. No periosteal bone formation was shown from the cortex or in the muscles. The plate made five months after the first operation showed practically the same conditions except that there was thinning of the cortex with pointed bulging where the tumor had eroded the bone. The plate made immediately before amputation (seven months after the first operation) showed more bone destruction with periosteal new bone formation along the inner surface of the shaft extending into the muscles.

Report of the Blood Examination.—Wassermann negative; white cell count 8,700 with 55 per cent polys., 33 per cent lymphocytes, 3 per cent large monos., 2 per cent eosinophiles, 6 per cent basophiles.

A diagnosis of medullary tumor of the femur was made, and the patient was taken to the hospital for operation several weeks after being first seen. At this time there was a tumor about the size of an orange over the anterior lateral surface of the upper third of the thigh. A long incision was made over the site of the tumor, which was found to be a bulging upward of the crureus muscle from the shaft of the bone and cystic in character. On cutting into the tumor it was found to contain gelatinous material characteristic of a myxomatous tumor. There was no blood in the cyst and grossly it did not look like sarcoma. From the gross examination both Dr. McCleary and I made a diagnosis of myxoma. The femur was exposed throughout the entire area of enlargement. A sinus was found leading into the medullary cavity of the bone, and the cortex of the bone was enlarged from the greater tuberosity to the middle of the femur. There were no osteophites present or bony growths in the muscle. The outer surface of the femur was smooth and normal in appearance except for the enlargement. With the chisel and curette, the entire

FIGS. 1 AND 2. LEFT FEMUR, HIP AND THIGH ONE MONTH BEFORE OPERATION.

affected area of bone was removed leaving only a posterior shell of the shaft. The bone was packed with gauze and the soft parts partially closed. The patient had a satisfactory convalescence and the wound entirely healed in about four months. At this time the patient had no pain and seemed to be entirely well and was able to resume his occupation. Within two months after the healing of the operative wound, the patient noticed a swelling of the thigh at the site of the previous operation, which increased rapidly. There was no pain at this time. A diagnosis of recurrence of the tumor was made and the patient advised to have amputation at the hip joint. Disarticulation was done in December, 1918. Microscopic examination of the amputated specimen by Dr. Standish McCleary showed myxochondrosarcoma. Dr. McCleary's report is as follows:

Original Examination.—The material examined was of a gelatinous consistency and sections made from numerous blocks of tissue showed the same structure. Microscopically there were seen cartilage cells of various sizes, irregularly grouped, lying in a stroma which was distinctly myxomatous both in its structure and its reaction to stains. A few blood vessels had grown into the tissue. At some places new cartilage was seen developing and there were a few minute areas of calcification. Not the slightest suggestion of sarcoma was apparent in any of the numerous sections. The impression was that we were dealing with a chondroma which was undergoing a myxomatous change and in places forming actual cysts.

Figs. 3 and 4. Five Months after First Operation.

Tissue from the Amputated Limb.—Sections from the medullary cavity showed that the cartilage cells were less numerous and the matrix was invaded by masses of cells chiefly, round which showed various nuclear abnormalities and every evidence of rapid proliferation. There were areas in which the myxomatous substance still remained, but the striking feature was the great preponderance of the sarcomatous elements. Beneath the periosteum the proliferated cells were chiefly spindle.

The points of most interest in this case are, first, what was the nature of the original growth, and second, was the tumor malignant from the beginning or was it a benign tumor in which a malignant process subsequently occurred? I am inclined to the opinion that we were dealing with multiple chondromata in which a myxomatous change was developed, forming the gelatinous cyst-like masses, and that subsequently a sarcomatous change developed in the cells of certain areas of the original tumor which were not removed. It is possible but unlikely that there were malignant areas from the beginning which escaped detection. The question of the transformation of a benign into a malignant tumor has long been an oncological battle-ground. We are of those who believe that such a change is possible but infrequent, as is so well illustrated by the pigmented moles. Most of these are benign throughout the life of the host, yet no one will deny that they may become frightfully malignant.

The patient did well after the operation and the wound healed in two months. Again the patient resumed work apparently all right. About March 1, 1919, the patient noticed a painless swelling in the groin, which increased to the size of a large orange. *X*-ray treatment was given at that time, a hard ray being used through a 3 mm. aluminum filter. Sufficient dosage was given to produce marked erythema. The *X*-ray had no effect upon the tumor. On April 24, 1919, the tumor was excised. It was found to consist of the same myxomatous tissue found in the femur. The operative wound healed by granulation in about six weeks. About the time this wound healed the patient developed a cough followed by a hemorrhage from the lungs. This cough began in March, and the first hemorrhage occurred in May, 1919. The patient had a second hemorrhage in July. At that time *x*-ray examination of the chest was made and characteristic metastases were shown in the right lung.

About the middle of June, a hard swelling appeared in the center of the amputated stump. An incision was made over

FIG. 5. IMMEDIATELY BEFORE OPERATION.

FIG. 6. SPECIMEN OF AMPUTATED FEMUR.

the swelling under local anesthesia. A mass of blood clots were removed followed by free bleeding. The bleeding was so free, in fact, that the patient had marked constitutional symptoms and it was necessary to pack the wound very tightly and to give constitutional treatment for hemorrhage. The patient rallied and since that time the cavity of the recurrent tumor of the stump has been treated by cleansing and packing. This area has the characteristic appearance of sarcomatous tissue, bleeds easily and is attended by a marked odor of putrefaction due to necrosis of tissue. The patient's general health is gradually failing. He suffers considerably from dyspnœa and periodical coughing spells. He now has recurrent sarcoma of the stump and metastases in the lungs.

FIG. 7. METASTASES IN RIGHT LUNG.

In comparing the clinical history of these two cases of myxoma of the femur we note in the early stages the following points of resemblance: slow onset; obscure symptoms; predominating symptom, pain resembling sciatica; difficulty in making a diagnosis; later great destruction of bone with enlargement of the thigh and loss of function of the limb; finally, recurrence with malignancy in both cases.

Comparison of the points of resemblance in the x-ray examination of these two cases shows that both originated in the medullary cavity; that both were attended by enlargement of the medullary cavity and expansion of the cortex; that later on there was breaking through the cortex and periosteum and extension of the tumor into the muscles; that there were cystic areas in the soft tissues due to the tumor mass pushing out the muscles, and that there was irregularity in outline of the cortex.

The following points of difference were noted: The x-ray examination of the second case was made at an earlier stage and before exploratory operation was done. In the second case there was less thinning of the cortex and periosteal bone formation. The tumor extended from the great trochanter only to the middle of the shaft of the femur. Below the middle the femur was normal in appearance. There was no new bone formation in the muscles where the cystic areas were found.

Comparison of the pathological reports.—Dr. McCleary's pathological report in the case of Mrs. D. (the first case) showed pure myxomatous tissue with evidence of processes of repair and of bone absorption. The pathological report of the second case, C. W., showed, first, myxochondroma. The second report made after amputation showed myxochondro-sarcoma.

These two cases have given us a rare opportunity for studying myxoma of bone. Very few cases have been reported. A detailed search of the literature two years ago failed to reveal any cases of pure myxoma of bone reported. Several cases of myxochondroma and myxo-sarcoma were found. Whether or not myxoma as a tumor should be considered an entity has been a mooted question among surgical pathologists. Fisher, in the June number of the *Annals of Surgery*, reports a case of pure myxoma of the labium majus. In this

article he has summarized the views of a number of pathologists. He quotes Adami as follows: "Many pathologists doubt whether we ought to regard the myxoma as a separate form of tumor, and urge that we should speak rather of myxomatous modification or degeneration of some one or other form of connective-tissue neoplasm—of lipoma, chondroma or fibroma myxomatodes, rather than of myxolipoma, etc. As such the majority of so-called myxomas must be regarded. But Ribbert has described small pure myxomatous tumors of the endocardium. Further, cases have been recorded as congenital myxoma, the tumors being recognized at the time of birth."

Bland Sutton states: "It would be convenient and perfectly justifiable to deprive myxomata of even the rank of species among tumors."

Mallory says it is "a comparatively rare tumor and therefore clinically of minor importance. It is questionable whether it deserves recognition as an entity. A true primary myxoma which has its origin from embryonal mucous tissue is rare." He also says that "secondary myxomas may develop by degeneration of mesoblastic tumors, such as occur in fibroma, lipoma, and chondroma."

Ribbert maintains the independence of the myxoma as a distinct tumor which may be combined with cartilage or with bone, etc., to form a myxochondroma or myxo-osteoma.

Bloodgood says: "Pure myxomas are rare bone tumors. I have observed one exhibiting itself as an exostosis of the shaft of the humerus; I have seen it combined with cartilage as a multiple lesion arising from the rib, and as a periosteal growth from the os calcis."

Fisher states in the report of his case: "I am convinced that pure myxoma should be classified as an entity."

It is evident from the quotations cited that pathologists do not agree on this subject. Some regard the condition as purely a degeneration of some other form of tumor, either benign or malignant. Others recognize it as a benign tumor which may remain benign or become malignant. From the history of these two cases, whether we consider myxoma a primary tumor or a secondary degeneration of a pre-existing tumor, there is a marked tendency to malignant degeneration.

Dr. Coley has called attention to the unreliability of the frozen section in the diagnosis of tumors while you wait at the operating table. The benign portion only may be present in the specimen and the malignant portion missed. For this reason it is much better to form a judgment from the gross appearance at the exploratory operation than to depend upon the frozen microscopic sections.

The practical points to be considered by the surgeon are: (1) Are these tumors primarily chondrosarcomata which have undergone myxomatous degeneration? (2) If primarily myxomata or myxochondromata, what per cent undergo malignant degeneration and become sarcomatous? (3) Are we justified in treating these tumors by conservative operations?

Diagnosis of myxomatous tumors of bone must be made by careful study of the clinical history, signs and symptoms, *x*-ray plates and by the exploratory incision. It is questionable whether or not a diagnosis can be made from the clinical history signs and symptoms and the *x*-ray examination. The *x*-ray plates tell us that we are dealing with a medullary tumor of bone, but whether it is myxoma, bone cyst or ostitis fibrosa is a difficult question to determine. Diagnosis must finally be made from the exploratory incision and the examination of the gross tumor. Frozen microscopic sections cannot be depended upon.

The question of the treatment of these tumors is a most important one for the patient. The question of conservative treatment is applicable only to early cases. Late cases require amputation at the hip joint to relieve a painful, functionless limb. Conservative operation means a more or less extensive operation, the object of

which is to remove all tumor tissue by the chisel and curette or by cautery and to retain the function of the thigh. The treatment by the chisel and curette would be similar to the operative treatment for giant cell sarcoma. Radical treatment means amputation at the hip joint with the loss of one-fourth of the patient's body. If, following an exploratory operation, the pathologist reports a benign tumor, the surgeon is naturally inclined to conservative treatment. If a similar report is received from a careful study of the amputated femur of advanced cases, the surgeon is inclined to believe that he has cured his patient. The history of these two cases that have come under our observation would seem to teach us that conservative treatment is never indicated and that we cannot assure our patient that recurrence will not take place, either *in loco* or by metastasis. It is practically impossible to remove all tumor tissue by the chisel and curette, which fact makes a recurrence *in loco* probable. Whether these tumors are primarily sarcoma or primarily chondroma or myxoma with later sarcomatous degeneration, they ultimately become sarcomatous in a large proportion of cases, especially in cases of recurrence after conservative operative procedures.

With these facts before us there can be very little room for argument as to treatment. The proper treatment of these cases is radical—that is, amputation well above the tumor as soon as a diagnosis is made. In case the tumor is located in the middle or upper third of the femur, amputation at the hip joint should be done. The patient should be prepared for hip-joint amputation at the same time the exploratory incision is made into the tumor for diagnosis. If the tumor shows the *gross* appearance of myxoma, myxo-chondroma or myxochondro-sarcoma, the exploratory field should be isolated, and with fresh instruments, gloves, etc., disarticulation of the hip-joint should be done at once. It may be argued that if the tumor is already sarcomatous amputation will not cure the patient, and such a mutilating operation as hip-joint amputation is not justifiable. In answer it may be said that conservative treatment, including the chiseling and curetting operation, offers no chance of a cure or more than a temporary relief of the symptoms. On the other hand, early amputation well above the tumor even in sarcoma will relieve the patient of a very painful condition and prolong life. In cases in which the tumor has the gross and microscopic characteristics of myxoma or myxochondroma only, early amputation should cure the patient. To be successful, the operation must be done early and well above the tumor tissue.

[NOTE: The patient whose case is reported above died Sept. 20, 1919. A piece of tissue from the ulcerated stump of the amputated limb was obtained. The following is Dr. McCleary's report of the examination of this tissue:

The tissue consists almost exclusively of spindle cells, many of which show marked abnormalities in nuclear structure. Among the spindle cells are a number of minute islands of hyaline cartilage about a millimeter in diameter. The presence of this cartilage in the recurrence in a soft part is most interesting and may be considered as a confirmation of our theory that the original tumor was a chondroma which subsequently became a sarcoma. The presence of the cartilage among the sarcomatous tissue is easily accounted for by some of the cells composing the sarcoma reverting to the type of connective tissue from which they originally developed.]

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DISLOCATION OF THE INNOMINATE BONE *

BY JOHN T. MURPHY, M.D.

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MY object in presenting this subject is to call attention to either a very rare condition or one that has been much neglected in medical literature. In this paper it is my aim to discuss only the distinctly traumatic type, cases in which the injury was severe and the pathology definite. In this manner I hope to avoid a promising but not very satisfying study of the less pronounced sacro-iliac pathology with which we are all familiar.

The condition is defined as a separation of the innominate bone from its attachments and its displacement upward and backward, the dislocation occurring without fracture of the bone. The condition is not of much importance from a clinical viewpoint, because it is so rare; but it is from the small number of reported cases that an added interest arises. This applies especially to the roentgenologist, as it is upon him that the diagnosis depends.

The pathology is a tearing of the anterior, posterior and the interosseous ligaments of the sacro-iliac joint and of the symphysis pubes. In the most severe cases even the sacro-sciatic ligaments may be ruptured. The diagnosis with the aid of the radiogram is easy; the inequality of the two sides is very evident. A stereoscopic set of plates is an aid, as they show the posterior displacement. Clinically there may be but little difference in the appearance of the two sides. Measurement if made in the usual manner, from the anterior superior spine of the ilium to the inner malleolus of the tibia, will show both sides to be of equal length; if, however, the measurement is made from the umbilicus or better still from some fixed point higher up, a difference will be found that will correspond to the upward displacement of the bone. Changes in appearance when present and the difference in the measurements may also be found in vertical fractures of the sacrum.

Treatment of the latter condition might be very similar to that of a dislocation, but the prognosis might be very dissimilar, due to the nerves enclosed in the sacral canal. In determining the prognosis the separation of the bones is not of much importance. It is the injury to the soft parts that we must consider, rupture of the bladder, of the pelvic colon or of the rectum; and injuries to the large blood vessels and nerves are the causes of immediate death or subsequent troubles. The shock of so severe an injury is always an important factor and must be considered in all cases. As a general statement of the reported cases, those who survived the original shock recovered.

The treatment is reduction, when possible, and fixation as in fractures of the pelvis. Complete reduction was accomplished in only two of twelve reported cases, one case was partially reduced, one case reduced itself, and in five cases no reduction was possible.

A careful review of the world's literature made by Simpson in 1918 revealed only fifteen authentic cases, two of these being complicated by small fractures. To this he added a case of his own, and as the history is typical of most of the reported cases I will quote it.

A man fifty years of age, while on his hands and knees at the bottom of an elevator shaft, was struck on his back when the elevator descended. The shock was very severe; the left thigh was flexed on the pelvis, the leg on the thigh. The leg was abducted and rotated inward. *X*-rays showed a wide separation of both the sacro-iliac and the symphysis pubes. The result is given as recovery in ten months without shortening or loss of function.

* Read before the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3-6, 1919.

The history of the case I wish to report is as follows: boy aged six years fell from the seat of a farm wagon loaded with 3,200 pounds of coal, and the front wheels passed over his abdomen. Shock and prostration were marked. Patient could not be moved for ten days, when he was brought in for examination, the result of which was as follows: Well nourished boy, not in pain and apparently in good condition. Leg flexed and foot everted. Large hematoma covered the entire lumbar region. *X*-rays revealed the condition as shown in the slide. Attempted reduction failed; fixation in plaster for three weeks, recovered, function normal.

FIG. 1. DISLOCATION OF INNOMINATE BONE AS RESULT OF SEVERE INJURY.

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DISCUSSION

DR. G. C. JOHNSTON.—I believe those cases are not so scarce as they are supposed to be. They are not reported. In Pittsburgh we have accidents due to mine crushes and these injuries occur with excessive traumatism, and I know I have seen three such cases, not of dislocation alone but of dislocation accompanied by other injuries. In each case there was a great amount of force, either due to a fall of slate (several tons), or crushing between mine cars.

ARITHMETICAL COMPUTATION OF ROENTGEN DOSAGE *†

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The so-called indirect or electrical method of estimating the roentgen dose antedates all other schemes of measurement in practical work. Before the advent of the interrupterless transformer and the Coolidge tube, this method was unreliable and gave way to the so-called direct technic, where pastils or photographic paper instead of spark gap, milliamperage, time and distance were employed. To-day, however, with modern apparatus and indirect technic, it is possible to duplicate results at will.

The technic outlined in this article is

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based on the invaluable work done by the eminent American physicist, Prof. J. S. Shearer,[1] of Cornell University, and experimental and practical work done in the author's laboratory by the latter's associate, John Remer,[2] in collaboration with W. D. Witherbee of the Rockefeller Institute.

TECHNIC OF ELECTRICAL MEASUREMENT

In electrical measurement there are four essential factors, namely, milliamperage, voltage (spark gap), time and distance. These are the constants or factors that establish the technic. It is possible with modern apparatus to obtain and maintain these factors with an accuracy that fulfills practical requirements.

With 2 milliamperes of current, a 6 inch sharp or blunt pointed spark gap, a distance of 8 inches from anode to skin and an exposure of 3 minutes, a definite amount of rays will reach the skin. It is obvious that every time these factors are used and maintained throughout the exposure, the quantity of rays reaching the skin will be the same. It becomes feasible, therefore, to establish a technic that is sufficiently accurate for practical purposes, that will duplicate results and that can be passed from one operator to another.

It is advisable for the operator to know how much ray, in terms of units, is obtained with a given set of factors. This information can be ascertained in one of two ways: by biologic or radiometric standardization.

BIOLOGIC STANDARDIZATION

Let us adhere to the constants already given—Ma. 2, Sp. G. 6 in., T. 3 min., D. 8 in. Utilize a split-pea sized area of skin on the flexor surface of the forearm of a female adolescent (preferably a blond) for the experiment. Establish all the constants except time. Make an exposure of one minute and wait two weeks for a possible erythema. If none appears, expose a similar area for two minutes and so on. Assume that the third area exposed (three minutes) develops a faint but definite erythema—Ma. 2, Sp. G. 6, T. 3 min., D. 8 in., will be the erythema dose and this particular technic is standardized. Any set of constants may be employed, but with every set used it is necessary to ascertain the erythema dose as above outlined. After the erythema dose has been established, it is necessary only to split the time to determine fractions thereof. The reason for selecting a young fair skin and a flexor surface is because such skin is more sensitive than dark skin on the extensor surface of older individuals. Obviously, it is preferable, for the sake of safety, to standardize the erythema dose on sensitive normal skin rather than on comparatively insensitive skin. The objection to the biologic method is the amount of time required for standardization.

RADIOMETRIC STANDARDIZATION

This consists of utilizing pastils or photographic paper to determine the time required for the erythema dose with a given set of constants. The method has the advantage of requiring only a few minutes, but it demands considerable experience with at least one reliable type of radiometer.

Before proceeding further it is necessary for the reader to understand and memorize certain physical laws:

1. Intensity varies directly as the square of the voltage (photographic).
2. Intensity varies directly as the voltage (biologic and pastil).
3. Intensity varies directly as the milliamperage.
4. Intensity varies directly as the time.
5. Intensity varies inversely as the square of the distance (unfiltered).

All methods of measurement agree with these laws excepting that relating to

1. Shearer, J. S. Factors Governing Photographic Action of Roentgen Rays, *Am. J. Roentgenol.*, Dec., 1915, p. 900; The Physical Aspects of Roentgen Ray Measurements and Dosage, *Ibid.*, June, 1916, p. 298.

2. Remer, John, and Witherbee, W. D. The Action of the Roentgen Ray in Plate, Pastille and Skin, *Am. J. Roentgenol.*, June, 1917, p. 303.

voltage (spark gap), where photographic and pastil methods give contrary results. Biologic experiments, however, support the pastil, so for unfiltered superficial therapeutic work we must accept the second law while the first is applicable to diagnostic work.

To explain these laws in a different manner: 1. Doubling the spark gap doubles the dose. 2. Doubling the milliamperage doubles the dose. 3. Doubling the time doubles the dose. 4. Doubling the distance gives one quarter of the dose.

It should be clearly understood that these laws pertain only to superficial therapeutic work with unfiltered rays. It is also of the utmost importance to realize that "distance" means from the anode to the skin; not from the glass wall of the roentgen tube to the skin.

It is preferable that the roentgenologist become accustomed to the use of equations, because mathematical formulas allow of visualization and arithmetical computation. The following formula is for *unfiltered* ray in *superficial* therapy:

$$\frac{\text{current} \times \text{voltage} \times \text{time}}{\text{Distance} \times \text{distance}} = \text{intensity at the surface.}$$

or, expressed in arbitrary figures:

$$\frac{20 \times 5 \times 4}{20 \times 20} = \frac{400}{400} = 1$$

Now if voltage is doubled, intensity is doubled; thus:

$$\frac{20 \times 10 \times 4}{20 \times 20} = \frac{800}{400} = 2$$

The same results will be obtained by doubling time or milliamperage.

These laws having been repeatedly controlled by pastil and experiments on living individuals, it became possible to establish a standard formula possessing a definite biologic value with which any dose with any set of factors might be arithmetically computed.

The following standard formula was established as representing the so-called skin unit:

$$\frac{3 \times 3 \times 4}{8 \times 8} = \frac{36}{64} = 1 \text{ skin unit}$$

A digression is necessary here to explain the meaning of a "skin unit." By pastil measurement it represents one unit on the Holzknecht radiometer at skin distance or H 4 at half distance (Hampson 4; Kienbock 8). It is the amount necessary to depilate scalp hair without erythema (epilating dose). It will provoke a slight erythema, if given at one sitting, on very sensitive parts, such as the face of a young girl (erythema dose). It is perfectly safe to administer 1¼ skin units to the scalp, and it sometimes requires this amount and more to effect an erythema of the skin of the body, but for the sake of safety it has seemed preferable to establish the skin unit as above outlined.

STANDARD FORMULA AND ITS USE

In order to demonstrate arithmetical computation the following examples are given: If time is increased by one minute, what will be the result?

$$\frac{3 \times 3 \times 5}{8 \times 8} = \frac{45}{64}$$

The product of this formula is divided by that of the standard formula thus:

$$\frac{45}{64} \times \frac{64}{36} = 1\tfrac{1}{4} \text{ skin units (H 5)}$$

What will be the dose if the spark gap is doubled?

$$\frac{3 \times 6 \times 4}{8 \times 8} = \frac{72}{64} \times \frac{64}{36} = 2 \text{ skin units}$$

Suppose the distance is changed from 8 to 12 inches the result will be:

$$\frac{3 \times 3 \times 4}{12 \times 12} = \frac{36}{144} \times \frac{64}{36} = \frac{64}{36} = 0.44$$

(a little less than ½ skin unit)

With 2 milliamperes, a 6 inch gap and an exposure of 3 minutes, what distance would be required to obtain 1 skin unit?

$$\frac{2 \times 6 \times 3}{X^2} = 1 : 1 : X^2 : 64$$
$$X^2 = 64$$
$$X = 8 \text{ inches distance}$$

If ¼ skin unit were desired, using the same factors, what distance would be required?

$$
\begin{aligned}
1 : \tfrac{1}{4} &: X^2 : 64 \\
\tfrac{1}{4} &: X^2 = 64 \\
X^2 &= 256 \\
X &= 16 \text{ inches}
\end{aligned}
$$

If the milliamperage is changed from 3 to 2 the result will be:

$$\frac{2\times3\times4}{8\times8}=\frac{24}{64}\times\frac{64}{36}=\text{about } \tfrac{2}{3} \text{ skin unit}$$

If the operator finds it more convenient to employ 2 milliamperes, a 6 inch gap and a distance of 8 inches, how much time will be required for the administration of 1 skin unit?

$$\frac{2\times6\times T}{8\times8}=\frac{12}{64}\times\frac{64}{36}=3 \text{ minutes}$$

The formula will therefore be:

$$\frac{2\times6\times3}{8\times8}=1 \text{ skin unit}$$

which may be used as a basis of a dose chart such as herewith appended. This chart is employed for all routine unfiltered work in the author's laboratory.

MILLIAMPERE MINUTES

Not infrequently roentgenologists find it convenient to combine, by multiplication, the tube current in milliamperes, and the time in minutes, and express dosage in terms of milliampere minutes. But it must be clearly understood that the number of milliampere minutes allowable varies with spark gap and the distance. The standard formula $\frac{3\times3\times4}{8\times8}$ expressed in milliampere minutes would be: Sp. G. 3, D. 8, Ma-min. 12. Milliampere minutes may be split in any manner so long as the total is the same: 1 Ma. for 12 minutes; 12 Ma. for 1 minute, 6 Ma. for 2 minutes, etc.

PASTIL READINGS AND ARITHMETICAL COMPUTATION

Arithmetical computation, based on pastil and biologic standardization, has been worked out only for the skin unit and for the maximum epilating dose. If this method is employed for larger doses arithmetical estimation will not correspond with pastil readings. The following is offered as an example: The formula $\frac{2\times6\times3'45''}{8\times8}$ will give an erythema dose (H 1¼ skin distance) as proved repeatedly by pastil measurements and by experiments on human skin. If the time is doubled, other factors remaining unchanged, it is safe to assume that double the amount of ray has reached the irradiated surface. The pastil, however, will not register twice as much color—that is, it will not read 2½; in other words, if it requires 5 minutes to color a pastil from 0 to 1, more than 10 minutes will be consumed (about 12 minutes) before the pastil registers 2. The explanation for this error is that the pastil becomes less sensitive as it assumes color, and it does not obey physical and biological rules after 1 or 1¼ units are passed. In expressing dosage, therefore, it is advisable to indicate exactly what has been done—give the formula used and state whether estimation has been by pastil or by arithmetical computation.

ESSENTIALS OF SUCCESSFUL ROENTGENOGRAPHY

It is not the purpose of the author, in this article, to enter into electrical or mechanical details. Suffice it to say that one must be certain of the reliability of his milliameter, that there is no heavy leakage in the high-tension current, and that the apparatus in general is in good working order. The personal equation has been eliminated, but roentgenological technic is not yet fool-proof and never will be. A reasonable knowledge of electricity and roentgenology is essential.

The standard formula, arithmetical computation and the dose chart contained in this article will be found accurate and reliable if used with an interrupterless transformer (closed magnetic circuit type) of any reliable make and, of course, a Coolidge tube. Now that new types of apparatus are being placed on the market there is likely to be some confusion relative

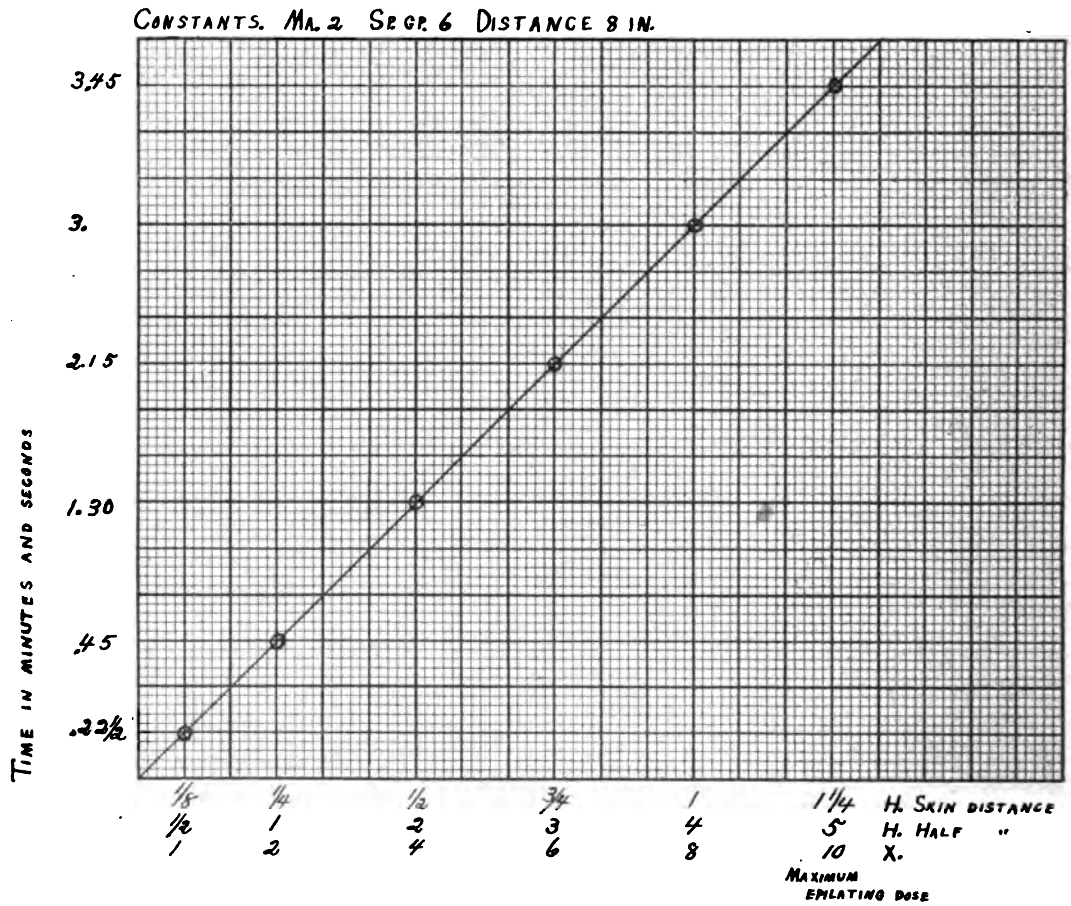
to the term "interrupterless transformer." To avoid this possibility the term is made to include a closed magnetic circuit transformer, operated by alternating current or by a rotary converter in case of direct current supply. The alternating, high-tension current is then rectified by a rectifying switch.

This is the popular type of apparatus at present. The so-called bedside unit may eventually supersede the interrupterless transformer in popularity. The method of dose estimation as outlined in this communication will not answer the requirements of this new apparatus. Experiments are being conducted and it is expected that a dose chart will be established in a short time.

It has seemed difficult for the novice to appreciate that in unfiltered superficial work the therapeutic effect is independent of quality and depends on quantity. That is, whether a 6 inch gap or a 9 inch gap is used makes no difference so long as the dose is correct. This is not absolutely true, for there are instances where it is advisable to employ a very penetrating ray, but in the majority of diseases, while there is a large theoretical difference, it is of no practical importance. For various reasons there is a limit to spark gap lengths in both directions, but for most skin diseases the length of the gap is of little importance providing it is not too short, say not shorter than 5 or 6 inches, and that the amount of rays administered are carefully estimated.

The author desires to thank his associate for invaluable help in the construction of the mathematical formulas.

Dose Chart



DISCUSSION

Dr. Pusey thought that Dr. MacKee was entitled to great credit for working out a technic for giving a measured dose of roentgen rays with accuracy. It was an entirely practical method, and in Dr. Pusey's opinion was a very useful step in the development of the technic of roentgen ray dosage.

Dr. Wise said he had been fortunate enough to be associated with Dr. MacKee and had watched his work and enjoyed his teaching, and had used his technic for some time with very successful results. He thought it was impossible for a man who had not done any roentgen work in the last years to apply this technic and use it with any great amount of judgment without preliminary study. Dr. MacKee was working on a book which would not only give the arithmetical rules, but would tell when to use the proper amount of dosage in the various diseases of the skin. When that was obtainable, with complete instruction on how to use and when to use roentgen ray therapy, the procedure would be free from danger and readily handled by the dermatologist.

Dr. Gilchrist said that Dr. Pusey and Dr. Wise had expressed so fully and so well what all the members felt about Dr. MacKee's valuable paper that he could only express his admiration and appreciation of the paper. Since Dr. MacKee had shown that it was faulty technic and not idiosyncrasy which was apt to cause burns, it behooved all roentgen ray operators to correct their technic. He recalled one instance where the same current which supplied the roentgen ray machine was also used to run the elevator in a hospital; and as a result the strength of the current to the roentgen ray machine would vary, unknown to the operator. In consequence of this he had seen two cases of radiodermatitis and one case of permanent alopecia of the whole scalp in a child because the dose had been measured while the elevator was running so that when the elevator stopped the current was increased in strength, probably double the amount.

Dr. Hazen stated that three or four years ago when he began to use a modern outfit, he had a good deal of trouble with the pastils, and found that there might be trouble in measuring the dosage. He therefore began measuring the spark gap and milliamperage of each dose and found that this could be done without any special device. He recently reported 225 cases of ring-worm of the scalp radiated without any pastil measurements and it worked out very beautifully. He had used a different milliamperage, a different spark gap and different distance, a spark gap of 7¾ inches, 1 minute and 10 seconds' time, and 9 inches' distance for epilating doses, and a milliamperage of 4, and it had worked out admirably in every case.

Dr. White said that he was not a roentgen ray expert but felt that he knew something about the effect of medicines and the behavior of the skin and therefore did not see why all skins would always react in the same way to roentgen rays any more than they did to medicines and other extraneous conditions.

Dr. Haase presented his personal thanks to Dr. MacKee for his contribution, and said that up to the week previous he had been afraid to use the roentgen rays. He thought Dr. MacKee would very shortly give the profession something that could be handled almost as safely as any other remedial agent. He thought that at the same time they would be governed by the reactions, the same as with any other remedial agent, which covered what Dr. White had just said.

Dr. MacKee said that on account of the late hour he would speak only on the subject of idiosyncrasy, a question brought up by Dr. White.

The existence of idiosyncrasy depended largely on the definition given the word. If meant to imply that a minute dose of roentgen ray (1/32–1/16–1/4 of an erythema dose) would produce a first, second or third degree reaction, then roentgen idiosyncrasy was an exceedingly rare phenomenon. In an experience of twenty years the speaker had failed to encounter such a case. If, on the other hand, idiosyncrasy were to include more or less hypersensitiveness or supersensitiveness from various known causes, then idiosyncrasy might be said to be common. The causes for hypersusceptibility were age, complexion, the part of the body, skin affected with certain diseases like mycosis fungoides and skin treated with salicylic acid, chrysarobin, mercury, sulphur, iodin, tar and other irritants.

In previous years, when technic was imperfect the word idiosyncrasy was in constant use. Its use had declined at about the same rate as skill in technic had increased.

A CONSIDERATION OF THE TREATMENT OF THE DISEASES OF THE THYROID WITH SPECIAL REFERENCE TO THE SO-CALLED HYPERTHYROIDISM*

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IT is intended in this paper to discuss the indications for the various treatments at present available and generally considered applicable for diseases of the thyroid gland. It is also intended to speak somewhat specifically of the present status of the medical treatment, especially in so far as the foundation for our faith in such a treatment is concerned.

When the diseases of the thyroid were first recognized medical treatment was about the only consideration which the various conditions received. By "medical treatment" is meant any medication or measure which does not include "cutting" or definite traumatism of the tissues. Later surgery came to the fore and quite naturally at first claimed the larger part of the field, and more recently the treatment by *x*-rays and radium has been advocated.

The question which generally arises is which treatment shall be applied in which case. For a certain patient shall the treatment be medical, surgical or roentgenological? There is frequent disagreement in answering this question. And even when the question is answered it is not always understood just what particular medical treatment, or what particular surgical measure or roentgenological procedure is to be followed. It is only by careful observation and research on the part of all and the free exchange of candid opinions that we can expect to accomplish the greatest good for this ever increasing number of unfortunate patients.

The differences of opinion which frequently arise among physicians are largely in the consideration of toxic goiters, and true exophthalmic goiter or Graves' disease. But since we have learned that any thyroid gland which is diseased, that is, possessing a definite pathology, may at certain times and under certain circumstances also become toxic, the ground for our differences has been somewhat extended.

However, this need not necessarily be so; in fact it should be quite the opposite. For if we are aware that a so-called simple goiter, or an adenoma, is liable at times to produce toxic disturbances, those conditions should receive prompt and proper attention, be it surgery or roentgenotherapy.

The pathology of the thyroid gland should receive the same consideration as similar pathology does in other parts of the body. Whether in some of these cases it should be an excision or a ligation or a reduction by *x*-rays or radium are questions which will depend largely upon the individual case.

If this is admitted we are brought back to our original statement, and that is that the chief difference of opinion occurs among the toxic goiters, whether they be primarily toxic or are secondary to recognized pathology. Even this difference would not be so great, or lead to so much misunderstanding, if thyroid disturbances were recognized earlier, and treatment were more prompt and more definite. In a paper in 1911 by Dr. John H. Musser on "Problems in the Treatment of Exophthalmic Goiter" (*Am. J. M. Sc.*, 1912, Vol. 143, p. 810), he says in his conclusions: "Finally my conviction is that the surgeon does too much and the internist too little in the treatment of goiter." If he had added that the internist does his "little" too late

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it would have described the conditions possibly more nearly as they were then and are even now.

The early symptoms of disturbances of the thyroid should be easily recognized. The definite loss of weight in spite of an unimpaired appetite; the increased amount of energy discharged; the physical and mental restlessness; the tremor; the loss of vascular tone; the acceleration of the pulse rate and the so-called "internal tremor" to which patients so frequently refer, should call one's attention to the over-functioning of the thyroid, and should demand immediate consideration. If these symptoms were taken at their face value and early treatment instituted, the results in many patients would be different. The surgeon and the roentgenologist would rarely see them. It is not the purpose of this paper to go into the details of the very early symptoms, but reference should be made to a test which has been suggested by Dr. Emil Goetsch in a recent paper (published in the *Clifton Med. Bull.*, Clifton Springs, N. Y.). It depends upon the activation of the thyroid gland by the subcutaneous injection of adrenalin. It is possible in this way, as it were, to anticipate a thyroid explosion, and to be thus forewarned. In fact, the reaction produced in certain cases of diseased thyroid by this test is so profound that it seems to unbalance the entire endocrin system. Further observations must be made before a true interpretation of the test will be available. But it points the way to vast possibilities for the early diagnosis of thyroid disturbances. The difference in results between the early and prophylactic treatment of thyroid disturbances and the treatment of late or neglected cases is clearly brought out in a comparison of the report of Marine in his work among about 3,000 of the Akron public school girls ("The Prevention of Simple Goiter in Man," *Arch. Int. Med.*, July, 1918), and that of W. Hale White on the results of the treatment of exophthalmic goiter as experienced in Guys Hospital ("The Outlook of Sufferers from Exophthalmic Goiter," *Quart. J. Med.*, Oxford, 1910–11). It is true Marine speaks of simple goiter while Hale White speaks of exophthalmic goiter; yet the one writes with the enthusiasm and hope which come from preventing a disease or from treating it in its very early stages, while the other seems simply to record the uninterrupted course and outcome of 169 apparently advanced cases admitted to Guys Hospital between 1894 and 1909.

In the interval between Hale White's report (1909) and Marine's report (1918), great advances have been made in our knowledge of the diseases and disturbances of the thyroid. The advances have come largely from laboratory observation. Points were confirmed which formerly had been surmised but were not definitely understood. For example, it was long recognized that the patient with exophthalmic goiter loses more or less weight. But it was not until Dr. E. F. DuBois had demonstrated satisfactorily that the basal metabolism in severe cases may be 75 per cent or more above the average, whereas in mild cases it may be only 50 per cent, that we had one clear and rational indication for treatment. We now prescribe unhesitatingly a full diet of very high caloric value. From DuBois' experiments and observations it appears without any doubt that increase in basal metabolism is in proportion to the severity of the disease. ("Metabolism in Exophthalmic Goiter," Dr. E. F. DuBois, *Arch. Int. Med.*, Vol. 17, p. 915.) This has been so generally recognized that some clinicians in certain cases are unwilling to make a diagnosis of hyperthyroidism until the basal metabolism is determined.

Another fact which has pointed the way in treatment is that brought out by Dr. W. B. Cannon in his work on the innervation of the thyroid. He concludes that the nerves distributed to the thyroid cells belong to the sympathetic and not to the vagus supply, and that their effects are not indirect through alterations of the blood flow; indeed that they are true secretory

nerves. The thyroid gland is subject to that division of the nervous system which is brought into action in emotional excitement. (Cannon, *Boston M. & S. J.*, 1916, Vol. 175, p. 152.) The experiences observed in the recent great war go far in confirming the work of Cannon.

This explanation of Cannon's thus again points definitely the way from etiology to a rational treatment. It implies a condition of imbalanced nervous function which must be restored. This is a definitely medical condition, and no one unto this day has better outlined such a medical treatment than S. Weir Mitchell in his method of rest treatment. The possibility of restoring nerve function and mental balance by the proper application of the principles laid down by Mitchell is recognized by all. The late Dr. Janeway in discussing a collection of papers referring to thyroid conditions and the various treatments therefor said: "I have seen that symptoms when recognized (early) permit of successful medical treatment in spite of the fact that, for the patients studied nowadays in hospitals, surgery is usually necessary. One of the reasons for the difference of opinion between surgical and medical men is that we tend more and more to treat our patients in hospitals. In private patients who early will cooperate, however, the medical man may accomplish cures, and cures which are permanent. Such patients must be carefully selected and more carefully managed." (Dr. T. C. Janeway, *Boston M. & S. J.*, 1916, Vol. 175, p. 685.)

This brings us to the crux of the goiter question in so far as treatment is concerned. It is the proper selection of cases for the various treatments. Early in my medical practice I determined upon a classification of goiter patients which has been very helpful to me and which up to the present I have not seen fit to abandon. It furnishes a rather satisfactory working basis for the determination of the proper treatment in the individual patient. It does not preclude any classification thus far suggested of diseases of the thyroid gland based upon demonstrable and well-recognized pathology. Patients having diseases of the thyroid gland are divided into four groups:

Group I.—Those patients having hyper- or hypo-thyroidism without any apparent pathological change in the gland. No change in the size or shape of the thyroid is demonstrable physically. These may be early cases in which later pathology will become manifest, or they may be well-advanced cases with no pathology of the gland. If one is keen in recognizing the early symptoms of thyroid disturbance, this class may be large. The symptom-complex, however, is usually quite definite. A study of the basal metabolism and possibly the application of the before-mentioned Goetsch test may be necessary to confirm the diagnosis in doubtful cases.

The treatment in these cases is definitely medical, which includes, as stated heretofore, any means which are non-surgical. I do not know of any attempts at treatment by *x*-rays in these cases, unless it be in those in which the thymus gland is enlarged. I have recognized two such cases, one of which was apparently cured two years ago by Dr. George C. Johnston and Dr. George W. Grier with *x*-ray treatment. This case will be published later after sufficient time has elapsed to warrant a definite statement.

Group II.—Those patients having an enlargement of the thyroid, but in which from the age of the patient and the absence of certain symptoms, the diagnosis of adolescent thyroid may be made. It occurs in young girls about the time of the establishment of the menstrual period. It may also occur in boys at the age of puberty. The enlargement is usually temporary. There are of course notable exceptions. If any definite treatment is necessary it is medical. Usually time and careful prophylactic measures may prevent the hyperthyroid syndrome.

One of my cases was a notable exception. A young girl was brought to me at the age

of twelve with a slightly enlarged thyroid. It had been noticed for about four years, or since she was eight years old. Advice had already been given that it was an adolescent goiter and would likely disappear in due time. There was no reason for advising anything to the contrary, as there were no symptoms. The tonsils were diseased and were removed without any untoward symptoms. Definite prophylactic care was instituted. When the periods came on at the age of fourteen there was no change in the size of the gland, but at the end of two years it was larger. No symptoms of hyperthyroidism were noticed, but the patient wished a lobectomy for cosmetic purposes if for nothing else. A partial lobectomy was done under local anæsthesia. The right lobe and the isthmus were removed. It proved to be a parenchymatous hyperplasia. Within a year of the operation the remaining lobe enlarged rapidly, and symptoms of hyperthyroidism were noted. A second operation was considered but finally it was decided to apply *x*-rays. After eighteen applications by Dr. Russell H. Boggs the swelling had about disappeared. This was three years ago. The patient lost her symptoms and seemed well. She has since been in college and has done heavy work. She had an operation for appendicitis and is living a normal life. The neck is normal and there are no symptoms.

This is undoubtedly an exceptional case, for among a large number of this group of cases this is the only one that seemed to require other than medical care. Most of these patients resume a normal thyroid after the menstrual periods are fully established. On account of this it is extremely difficult to estimate the real value of any treatment which may be instituted.

Group III.—Those patients having an enlarged thyroid with a definite hyperthyroidism active or at times potential. The enlargement may be due to a hyperplasia of a parenchymatous type (true Graves'), or it may be a colloid goiter, a cyst, an adenoma, or any combination of these conditions. This is a group of patients in which the course of treatment is occasionally extremely difficult to decide upon. It depends largely upon the stage of the disease or condition present at the very time the patient is seeking advice. Two principles must be kept in mind: (1) Any pathology of the thyroid gland should receive the same prompt consideration as similar pathology does elsewhere in the body. If the indications are for surgery it should be undertaken, if for *x*-rays the same obtains. More will be said of this when discussing Group IV. (2) Due regard must be given to the stage, or degree, of secretion of the thyroid gland, determined by its effect upon the general health of the patient, before deciding upon any course of treatment. In toxic goiters of extreme degree, and in true exophthalmic goiters, medical treatment may be the only *safe* treatment at first, and may be a necessary preliminary to later surgical or *x*-ray treatment. If after a successful course of medical treatment the thyroid gland still presents such pathology as would ordinarily require surgical interference, surgery should be undertaken promptly before there is a recurrence of disturbed function.

In certain cases the intoxication may have reached such a stage that medical treatment, i.e., physical and mental rest, abundance of food, support of the circulation and nerve sedatives, however carefully prescribed, will not bring about such amelioration as to make an operation a safe procedure. Under such circumstances it may still be safe to use *x*-ray treatment, either as a preliminary to operation, or without any thought of a subsequent operation. In these cases *x*-ray treatment has been most satisfactory. In several cases where it was begun only as a preliminary treatment, the results were so satisfactory that it was continued until the symptoms subsided and the swelling practically disappeared. Of course there are occasionally fulminating cases which run a rapid course and for which no treatment however carefully planned is of any avail. One such case

seen some years ago was most remarkable.

The patient was a child's nurse. She had charge of two only children in a family. Both contracted scarlet fever and died violent deaths within a week on account of kidney complications associated with uremic convulsions. The nurse, who was very much attached to the children, harbored the idea that she was directly responsible for bringing about the contagion. She could not be convinced to the contrary and brooded continually. She had previously been perfectly well. Her pulse became rapid, the thyroid gland enlarged, the eyes protruded and tremor developed. The diagnosis was evident. Notwithstanding every care, she became delirious, later comatose and died. The whole course of the disease was run in just two weeks. It will be seen that in Group III the success of any treatment is largely dependent upon the proper selection of cases. The problem is practically the same as it is in gastric and duodenal ulcer. There are some patients who will get well with medical treatment and remain permanently well, while there are conditions in others which will interfere with recovery until surgery is undertaken, or x-rays are applied, and finally there are those who will not recover with any treatment. These are the fulminating cases, or the neglected chronic cases with definite vascular or nervous disturbances.

Group IV.—Those patients having definite pathology of the thyroid, enlargement, without any disturbances of thyroid function. This group includes malignant tumors such as carcinomata, also the so-called "simple" goiters, or colloid growths, as well as the adenomata and cysts, and inflammatory reactions due to tubercular, luetic or other infections.

These are imperatively surgical conditions, especially when malignant or when producing pressure symptoms interfering with breathing or swallowing. Certain of these conditions, such as the adenomata and colloid goiters, yield satisfactorily to x-ray treatment, which under certain circumstances may be preferable; but in emergencies surgery is imperative.

By following such a grouping of patients as just described I have been able to advise more definitely as to the line of procedure in disease of the thyroid gland. There are of course border-line cases, but this occurs in any classification. The first group includes strictly medical cases; the second group may need nothing but prophylactic care; when they need more they are already in the third group; the third group may be medical for a time and later surgical or x-ray or both; the fourth group is surgical always, but presents an enticing field for x-ray investigation.

The physician who has only one treatment, be it medical, surgical, or x-ray, either sees only one class of cases or fails to recognize a large class which might be successfully treated otherwise. While I would prefer to have the surgeon and the roentgenologist settle their own differences, if there are any, on this question, as an internist I feel it my duty to express an opinion. The internist usually sees the cases first, no matter what stage of the disease may be presented. If medical treatment is not indicated, or if medical treatment has failed, he should be immediately in touch with the surgeon or the roentgenologist, or both. If he is as familiar with his case as he should be, he will go into such a consultation with pretty definite convictions. From my own experience I would say that as between surgery and x-rays, the former has a far larger field of application, and in skillful hands is comparatively safe. It has the added advantage of furnishing definite information, in that the tissue removed may be studied, and the nature of the pathology determined. This is of the utmost importance for the future conduct of the case. The roentgenologist necessarily is frequently not altogether sure of the condition with which he is dealing.

The results of operative treatment are

sometimes immediate, so that the patient is able, in a short time, to return to his usual life or occupation.

On the other hand, the x-ray treatment presents some advantages which cannot be passed by and which appeal to me very strongly. It is comparatively without danger; it leaves no scar; it is painless and gives very little inconvenience; if it is unsuccessful, surgery may be undertaken with possibly less risk. (Dr. Malcolm Seymour, "The Advantages of X-Ray Treatment," *Boston M. & S. J.*, 1916, Vol. 175, p. 568.)

The absolute safety of the procedure may be questioned. May it not be possible by x-rays to destroy the function of the gland entirely, as happens in the radiation of the ovaries, and produce a myxedema? The surgeon has been reminded of the dangers of removing too much tissue from the time he entered this field, and there are records of unfortunate results. What assurance has the roentgenologist that he may not have a similar experience? These are some of the questions which concern the internist especially.

In conclusion the following summary might be offered:

(1) Exophthalmic goiter, or hyperthyroidism from other causes, should be recognized early and treated promptly.

(2) The earlier it is recognized the more likely medical treatment will be sufficient and give permanent results.

(3) The neglected cases, or the cases having definite pathology besides, are likely to require surgery or x-ray treatment.

(4) The x-ray treatment of the enlarged thyroid presents most attractive advantages, but as yet the indications for its use do not seem so definite, and the results are not so certain.

(5) In hyperthyroidism the roentgenologist and the surgeon, at best, can only break through a vicious circle for which the internist may or may not have been responsible.

TREATMENT OF GOITER BY RADIATION*

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A SUFFICIENT number of cases of goiter had been treated in some roentgen laboratories throughout the world even ten or twelve years ago to give roentgen rays an important place in the treatment of certain forms of thyroidism; and with the advancement made since then their efficacy is to-day thoroughly recognized in a large proportion of properly selected cases. While many cases of goiter in the past ten years have been operated upon surgically, it is useless to claim that this is the only method to be applied, because in the same period an increasingly large number of cases have been cured by radiation and others by medication.

Before positive facts are established concerning the value of any method, a fairly definite conception of the life history of the disease must be obtained, as well as knowledge and comparison of the ultimate results in the case of patients undergoing the various forms of treatment and of those who have received no treatment at all. And results of the different methods must be compared for a period of at least five years in order to determine the differences from those to be expected in the natural course of the disease.

The physician best able to treat goiter must have developed sufficient judgment to enable him to select the medical, surgical or roentgenological treatment best adapted for each individual case. This can be determined only by a careful study of many factors. In the past there have

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been operations performed on the wrong class of cases at the wrong time, either too late, or at the height of the toxic symptoms. The same can be said of many roentgenologists; they have treated cystic and other forms of goiters and expected results, and many cases had been treated too long medically. When medical treatment is employed, the physician must realize that rest is an important factor, just as the surgeon, operating on goiter every day, realizes that an advanced case of exophthalmic goiter is inoperable unless the patient improves under rest in bed within a few days. The surgeon who operates on a case before making a careful study of the patient is just as injudicious as anyone who treats all forms of enlarged thyroids, regardless of the type, by radiation.

Before a surgeon or roentgenologist is qualified, he must have made a study of the physiology, the pathology, and the changes that take place in the glands, supplemented by a wide and comprehensive experience. Removing three-fourths to seven-eighths of the gland, giving a roentgen treatment, or applying radium in a hit or miss manner, is not treating goiter intelligently. In some cases in which even seven-eighths of the gland have been removed, the one-eighth left becomes so much hypertrophied that within a short time the patient may be worse than before. It has long been known that the size of the thyroid is not always in proportion to the toxic symptoms, and the other ductless glands often play a very active part in goiter. Toxic goiter is a disease of exacerbations and remissions. In the first place the diagnosis of goiter must be made and the further facts determined whether the enlargement of the neck is producing a systemic poisoning and whether there are other things that may be the matter with the patient.

Since this is a newer form of treatment, it is natural that there are still somewhat diversified opinions even among the roentgenologists as well as the medical profession. At present many roentgenologists have treated and studied a large number of cases, while others have only treated a few cases and have not given the subject serious consideration.

Tremendous advancement has been made in recent years in our knowledge of the physiology, pathology and treatment of the ductless glands. Improvement has been shown in exophthalmic goiter, by treating either thyroid, thymus or ovaries alone, but most of those who have treated goiter by radiation have treated the thyroid alone. It has been known for many years that thyroidectomy does not always remove all the symptoms of Graves' disease, and that in many instances the patients who have been operated upon are greatly benefited by roentgen treatment of the thymus or ovaries afterwards. It has been estimated by some investigators of exophthalmic goiter that the thymus is enlarged more or less in 90 per cent of the cases. When the thymus gland is greatly enlarged, patients do not stand operation well, frequently suffering severe shock from the operation, sometimes followed by death. A majority of the cases of exophthalmic goiter are of thyroid origin, but they may be complicated by thymic hyperplasia. It is true that we have a few cases of Graves' disease of purely thymic goiter, but a large proportion of the cases are either of purely thyroid origin or a combination of both forms. This explains why those who have only treated the thymus alone have not had uniform and lasting results.

It is natural to expect results from both roentgen rays and radium in goiter, since both have such pronounced effect on glandular or epithelial cells. It is not necessary at this time to describe the physiological action of the roentgen rays or radium, any further than to say that the glandular substance can be made to undergo a fibrous degeneration. It is well known to all roentgenologists that radiation has a wide latitude, depending upon the dosage on glandular cells. Small doses will only retard the activity or the function of the gland, but by increasing the quantity of radiation the injury becomes more pro-

nounced and, as before stated, many of the cells are completely destroyed. This explains how both roentgen rays and radium reduce the activity of the thyroid and relieve the symptoms in goiter. The gland undergoing a fibrous degeneration explains why all the symptoms may disappear after a course of radiation, and the gland itself may only have been reduced one half or one third.

A satisfactory classification of goiter is difficult, owing to the necessity of bringing into harmony the pathological with the clinical facts. For a long time goiter has been grouped roughly as exophthalmic and simple goiter, but at present it is well known that such a classification does not properly represent the clinical and pathological conditions. Crotti classifies enlargements of the thyroid gland as benign and malignant tumors and inflammations. Benign tumors or goiters (those under discussion) he divides into parenchymatous and colloid goiters. The parenchymatous are subdivided into physiological, non-toxic and thyroid-toxic; and the colloid into cystic, fibrous, calcareous and osseous. The microscopical picture of parenchymatous goiter is a picture of a more or less normal gland in which the structures show an increase in size and number but have more or less kept their natural relation to each other. Colloid goiter varies in degree considerably, and the main characteristic is an increase in the quantity of colloid. Colloid degeneration may be localized in a portion of the thyroid or may affect the entire gland. Colloid goiter may later give rise to a cyst. The cyst may produce a chronic irritation or inflammation, thus forming a fibrous goiter. Even in diffuse colloid goiter every follicle has not undergone colloid degeneration. There are always a number of normal vesicles between the degenerated follicles, which will proliferate and form new alveoli to make up for the lost function of the degenerated follicles. Adenomatous goiter of either fetal or adult type may be encapsulated or diffuse, and pathologically show a regeneration of a previous atrophic parenchyma.

At the Mayo clinic they have classified goiter as hyperplastic and non-hyperplastic. Between January 1, 1909, and January 1, 1913, of 2917 cases coming to operation 42.8 per cent were hyperplastic and 57.2 per cent were non-hyperplastic. Of the hyperplastic, 99.2 per cent were toxic and .8 per cent were atoxic. Wilson of the Mayo clinic states: "The pathology of the thyroid in true exophthalmic goiter is essentially a primary parenchymatous hypertrophy and hyperplasia, i.e., an increased amount of functionating parenchyma, associated with an increased absorption. The process is an acute one. The pathology of atoxic simple goiter is marked essentially by atrophic parenchyma, decreased function and decreased absorption. The process is a chronic one. The pathology of toxic non-exophthalmic goiter (i.e., those resembling exophthalmic goiter) is one of increased parenchyma through regenerative processes in atrophic parenchyma of the fetal type, with an increase in each instance of secretory activity and of absorption. The process is a chronic one."

The symptoms of hyperthyroidism vary somewhat in type as well as intensity, and are not proportionate in many cases to the size of the thyroid. There are all grades of hyperthyroidism, varying from a typical case, with all the symptoms well marked, to a case with simple nervousness, characterized by slight cardiac irritability, muscular tremor, with no or only slight exopthalmos, and the thyroid may vary in size from slight or no enlargement to enlargement of considerable size.

A fairly satisfactory working basis has been established at present through laboratory and clinical experience to determine the treatment of the overaction of the thyroid in exophthalmic goiter of the varying degrees and the method of treatment in glandular loss or activity or hypothyroidism. Further experience has shown that the two types of thyroidism may merge to a certain degree, certain clinical symptoms of hyperthyroidism often being overlapped by those of hypothyroidism.

The transitory symptoms produced by changes in the thyroid may not be due to hyperthyroidism or to hypothyroidism, but rather to dysthyroidism. This alone brings us up to the point which should show the profession that an excision of part of the thyroid gland or treatment by radiation requires a great deal of judgment. Experiments on animals have shown that there is a superabundance of the ductless glands with wide range of their functional activity which often permits the removal of a large proportion of the glands without apparent loss to the system. It has been estimated that a child needs at least one third of the thyroid, while the adult may maintain perfect health with one sixth of the gland.

There is a class of cases in which the value of roentgen therapy is too little appreciated even by men practiced in its use, i.e., the small or moderate sized goiter of adolescent females with few or no symptoms. Hitherto the best advice we could give those cases was to let their goiters alone. Medical treatment offered a problematical result; and since the cosmetic consideration was of chief concern, a surgical operation, with its resulting scar, was undertaken with reluctance. The thyroid over-activity of adolescent girls is no doubt usually physiological and compensatory, and may require nothing more than a careful mode of life. Moreover, the majority of these goiters disappear in a few years or a few months spontaneously. It is true we are unable to say which cases belong to the majority that would be cured by nature's method, or which would lead to a lifetime of chronic hyperthyroidism, by the conversion of glandular into cystic tissue, with its resulting permanent unsightly tumor which is always a potential danger by reason of mechanical pressure. In several such cases I undertook roentgen treatment, somewhat reluctantly, merely to secure a cosmetic effect. I was amazed to find that the treatment resulted not only in a distinct gain of weight and bodily strength, but also in the correction of a psychic instability which has been looked on as a matter of character rather than disease. From frivolous, flighty, irresponsible girlhood the patient passed into serene, well-ordered womanhood. In other words, they were suffering from hyperthyroidism, in so slight a degree as to give no characteristic symptoms, yet sufficiently to affect both physical and psychic strength.

When it becomes general practice to regulate, by judicious roentgenization, even minor aberrations of the thyroid function appearing at adolescence, I believe that we will not only prevent the chronic hyperthyroids and disfiguring cystic goiters of later life, but also add appreciably to the health and welfare of the community. C. H. Mayo, in speaking of goiter of adolescence, states: "Such glands are subject to degeneration, fibrous, cystic or calcareous." I began to treat a few adolescent goiters about twelve years ago, and I am glad to say that not any of these cases which were treated by the roentgen rays, so far as I know, have ever developed cystic or other degenerative changes, and that the results since that time in this class of cases have been uniformly successful.

There are three well known forms of treatment of goiter at the present time, namely, medical, roentgenological and surgical. The medical should always be considered first, as changes in the thyroid gland are produced by various conditions, such as infections, fatigue, pregnancy, shock, etc., and many times the symptoms will disappear when the patient is kept at rest under medical treatment. Focal infection should always be searched for and when found, treated promptly. There came under my observation a case following post-partum hemorrhage, and within six weeks all the symptoms of goiter had entirely disappeared, and the patient has never had any return.

Frequently in the past the statement has been made that the non-surgical treatment of goiter is attended with a higher rate of mortality than those treated surgically. The surgeon, like the roent-

genologist, sees the failure of others. The surgeon usually sees the failures of roentgen therapy more often than the successes, and the surgical failures are seen by the internist and are often referred to the roentgenologists. For the treatment of ductless glands roentgen therapy is not given the proper credence in some sections of the country, due to improper selection of cases. There is no question that treating a case too long medically, unless the patient is kept in bed, may be followed by permanent damage to various structures of the body; and since roentgen treatment has proved efficient and is not dangerous in the hands of a skilled roentgenotherapeutist, there is no necessity of delaying the treatment too long. The sooner roentgen treatment is given the more promptly the symptoms will be relieved, and the less radiation is required. Usually the younger the patient the more promptly the symptoms will yield.

When raying a case with grave thyroid autointoxication, it is necessary for us to begin carefully, because often after a week or ten days roentgenization a stimulation of the gland with an increase of the symptoms may result. This is always followed by relief of the symptoms to a certain extent after the first series of treatments. If the case is exhausted, the mere moving of the patient from the room to the roentgen laboratory, in addition to the excitement caused by the treatment, may greatly aggravate the symptoms. In such extreme cases it is usually best to wait until the acute symptoms have partially subsided before giving the treatment. The writer had one patient referred for treatment in which the symptoms were extreme, and bringing her in an automobile so greatly aggravated her symptoms that it was undoubtedly a dangerous procedure.

Now, with our present knowledge of roentgen rays in the treatment of goiter, patients should never be allowed to reach so precarious a stage before this method of treatment has been given at least a fair trial. Treating the thymus and ovaries is not sufficient, but the thyroid should usually receive the greater proportion of the treatment. Often patients suffering from goiter in the advanced stage are very easily discouraged, and to avoid disappointments it is important to have a thorough understanding with the patient before the treatment is given.

Patients with simple goiter having only an enlargement of the gland accompanied by nervous symptoms, will receive much benefit from a few roentgen treatments. The enlargement, which may be only in one lobe, can be checked and reduced in size, and the patient's health will be greatly improved. Raying a lobe of the thyroid is not any more dangerous than removing it surgically, because if the treatment is given carefully you can stop on the safe side. In cases of simple goiter, which are just beginning to show symptoms of the exophthalmic type, roentgen treatment should be given at once, because nearly all of these will be promptly relieved.

In the exophthalmic type, in which the symptoms are marked and damage has been done to other structures of the body, we must be careful in giving a prognosis as well as in giving the roentgen treatment. The gland in these cases is often easily affected, and the patient may be suffering from destruction or damage of the heart, nervous system, etc., and instead of hypersecretions of the thyroid, the patient is almost ready to pass from a hyper- into a hypo- condition. Then very heavy roentgen treatment is not indicated. Lately I have had such a patient, all whose symptoms were relieved after the first few roentgen treatments. She gained forty pounds in weight and her nervous system greatly improved. This is a case which I believe will become myxedema, and while the roentgen treatment relieved her symptoms, it is a question whether her thymus gland should not have been treated, omitting the thyroid, at least at first.

The treatment of goiter by the roentgen rays is major roentgenological work, and should not be attempted unless the physician is familiar with the disease as well

as the technique and physiological actions of the roentgen rays on the thyroid gland. Keen advises that the operation should be performed only by a surgeon who has had experience and practice in the removal of the thyroid gland. This applies with equal force to the roentgenologist, because we are dealing with a powerful agent.

The first improvement noted is the reduction of the pulse rate. Various authorities have found the decrease in pulse rate in 90 per cent of the cases, and it is possibly the best guide we have in regard to giving the treatment, because it has been pointed out that the stability of the pulse is more important than the reduction itself; that is, when it does not fluctuate with excitement or exertion. I have found that an increase in weight occurred in at least one half to three fourths of the cases after the first series of roentgen treatments. As soon as the pulse rate is reduced and becomes more or less stable and the patient increases in weight, the nervous symptoms, such as excitability, insomnia, etc., improve rapidly. The exophthalmos improved in many of the cases I have treated. Some authorities state that improvement is noted in fifty per cent of such cases. In my cases there was a reduction of the thyroid gland, at least to a certain extent, in over two-thirds of the cases of the exophthalmic type, and in about one-third of the cases the reduction was very marked. As before stated, we must go cautiously, and when the hypersecretion is reduced to normal, we must stop treatment, regardless of the size of the thyroid, because if carried further there is danger of producing myxedema. Further treatment can be given when it is deemed necessary.

There is some difference of opinion among physicians and surgeons as to when a patient is cured medically or surgically, some regarding a class of cases cured, while others regard them as only improved. Patients are usually not satisfied until there is a complete disappearance of the objective as well as the subjective symptoms. In the early cases both the objective and subjective symptoms will nearly always disappear, but when the disease has progressed beyond certain limits and when other organs are pathologically damaged, the patient will recover slowly under any method of treatment. Some advanced cases are symptomatically cured, but some of the objective symptoms are slow in disappearing or the deformity caused by the disease may never disappear, such as enlargement of the thyroid gland. Or in many instances the exophthalmos still remains in a more or less degree, yet the patient is apparently cured. In some instances the tachycardia still remains with certain nervous symptoms, yet the patient increases in weight and feels well. In these cases the question arises whether these symptoms are due to an acquired pathological condition instead of a toxic goiter. No matter whether the case is treated medically, radiotherapeutically or surgically, we must not be contented with the immediate results. In all cases the patient should remain under medical instruction for rather a long time.

INDICATIONS FOR ROENTGEN OR RADIUM TREATMENT

1. All forms of exophthalmic goiter derive benefit from both forms of radiation, and the symptoms can be relieved or the patient can be symptomatically cured in 80 per cent of the cases unless the disease is too far advanced. Nearly all cases can be both symptomatically and objectively cured.

2. The roentgen rays are useful in reducing the overactivity of the thyroid gland in exophthalmic goiter before operation, where the tumor is large and the symptoms are so intense as to make operation dangerous. When given as an anteoperative procedure, it is advisable to operate within four to six weeks, before fibrous tissue formation has taken place.

3. In relapses after operation for exophthalmic goiter, radiation should always be employed after a careful study of the ductless glands has been made, rather than the contemplation of a second operation.

4. Exophthalmic goiter in which other ductless glands play an important part, particularly if the thyroid is of only small or moderate size, should be given radiotherapy.

5. Adolescent goiters, which do not respond within a reasonable time to medical treatment, are benefited by radiation.

CONTRA-INDICATIONS FOR *x*-RAY

1. Colloid, cystic, fibrous and nodular goiter.
2. Goiter causing marked pressure without toxic symptoms.
3. Intra-thoracic goiters.

DISCUSSION

Dr. Isaac Gerber.—We have had the privilege of listening to two extremely important papers. Too much treatment is being done with little basic understanding of the physiology and pathology of the thyroid disturbances. Unfortunately Dr. Boggs mentioned nothing whatever of the technique of his treatment. It may sound rather impertinent to introduce anything like technical problems when we are discussing general principles, but the amount of available information, especially that which we are able to obtain from the text-books in English, is not at all satisfactory. Some men are indeed advocating the treatment of thyroid dyscrasias by methods which are exactly similar to those used in the treatment of malignancy. In fact in one of the most recent books on radiotherapy it is stated that the author intends to produce tanning in all of his cases of goiter. I believe that is very injudicious. From the statements we have heard today outlined by Dr. Lichty on the deep, underlying disturbances which we are dealing with, you will understand that when you produce tanning and atrophy of the skin, telangiectases and all that, that you are producing disturbances that will add to the psychic instability and defeat every bit of good that the radiation treatment has produced. We are not dealing with malignant disease. The treatment is not to be accomplished in a short time to save life, except in the fulminating cases in which treatment is of no avail. We are dealing with a complicated disturbance of the endocrine organs. What we are attempting to do is to break up the vicious circle of disturbance as was mentioned by Dr. Lichty. With all due respect to the histological observations, the radiation treatment of exophthalmic goiter is not yet entirely on a rational basis. We are not attempting merely to produce a partial atrophy of the thyroid. There is something more to the treatment. Just what the rest is I do not pretend to know, except that we are attempting to break the vicious circle of the end changes of ductless glands. This may require in some cases only a little push outside the circle to bring about a complete cure. In others it takes more time. Under these circumstances the doses are too high. We do not need an erythema dose, as is used in breast cancer. As a matter of fact, the same results clinically will be produced by administering one third to one half of a full erythema dose. You will very frequently with one treatment obtain an amelioration of the symptoms and reduction of *nervousness* and sweating just the same as is accomplished by the more intensive methods. I want to put in a plea not to treat these dyscrasias in the same way we deal with malignant disease. We are dealing with delicate problems, which require delicate treatment. As the treatment is in large part still empirical, we ought to go carefully with smaller doses. Then we will not produce those disturbances of damaging the healthy cells, and perhaps then we will not damage the vagus nerve and the cervical sympathetic ganglia.

Dr. George W. Holmes.—I can only agree with what has been said by the authors of the papers and perhaps say a little about the work we have been doing at the Massachusetts General Hospital. We have had a team consisting of an internist, a surgeon, and a roentgenologist, so that our cases have been studied from three different angles, an unusually fortunate arrangement for doing this work.

One of the things which has been spoken of, but not sufficiently emphasized I think, is the importance of the basal metabolism test. The cases we have treated have all been referred from the clinical department of the Hospital, and you would expect very good diagnoses; but when those cases were studied by the internists especially interested in the subject, a pretty large percentage have proven not to be cases of hyper-thyroidism. So that, if we treat either by the *x*-ray or surgery cases diagnosed by the average internist, I believe we will get a number of cases which are not true cases of hyper-thyroidism.

The basal metabolism also gives us a direct

check on the amount of toxemia that the patient is suffering from, the amount of activity of the gland, and by having it done at intervals during the treatment we get a check on the result of our dosage, so that we can increase it or decrease it, as the case requires, and then by so following the case we know when to stop direct treatment of the gland.

We have studied about 250 cases treated by *x*-ray. We have also had something like 40 or 50 cases that had surgery alone and a similar number had medical treatment only. Recently we wrote to these patients requesting them to return for re-examination, most of them have been under observation for about five years. Now a striking thing is that all who reported are well, a few had died following operation, and some from intercurrent disease, such as influenza. It did not seem to make any difference whether they were treated by surgery, medicine, or *x*-ray.

Of course, we cannot say what would happen if we had all of these cases early—whether or not we would then avoid the bad hearts which patients get from going through thyroid disease five to six years, I don't know.

Dr. Means and Dr. Aub have carried on the metabolism tests and thoroughly studied these cases. What I say now is largely quoted from them. Dr. Means plotted curves based on the metabolism, which are very interesting. The surgical cases have a sharp drop immediately after operation, some of them going down to nearly normal, but in a short time there is a distinct rise so that they go back to nearly where they were before operation, and this is the time that the surgical case comes in for *x*-ray treatment, and then, whether they have treatment or not, they drop and within five years they are normal.

If you start treating with *x*-ray instead of surgery, there is a steady drop and they get to normal about the same time the surgical case does. So that if you judge from end results, there is practically no difference in the two forms of treatment. None of the cases showed any improvement from drugs alone. That is, if if you put the patient to bed, you will get a drop down to a certain point; drugs will not increase this drop. After they reach that first drop from rest, we must decide upon either surgery or *x*-ray.

As to what class of case to treat by *x*-ray, I think we have gradually got round to using the metabolism test as a guide. If they have hyperthyroidism we treat whether the gland is enlarged or not. If there is no toxemia, as evidence by a normal metabolism, *x*-ray treatment is not indicated, no matter what the size of the gland may be. I have a case, a man with well marked hyperthyroidism, who drives a heavy auto truck. He has never had any enlargement of the gland, either external or internal, but by taking treatment he has been able to go on with his work, and at the present time is free from all symptoms except exophthalmos.

The treatment should be based on the amount of intoxication.

Another thing which Dr. Means has shown is the value of studying the relation of the pulse to the intoxication. Usually a rapid pulse and a high metabolism go together, but occasionally a case may have a relatively slow pulse and a high metabolism. This is the type of case which dies under operation. If a patient does not get a drop in metabolism with complete rest, it is probably unsafe to operate. At least, this has been our experience.

What I want to emphasize is the necessity of having these cases studied carefully by a good internist and then select them very carefully for treatment, having repeated basal metabolism tests done. We feel it is very much better than the Goetsch test.

Dr. George E. Pfahler.—I first want to thank Dr. Lichty for coming to us and to express my appreciation in general of the papers and the discussions. I agree first of all that we must be careful about our diagnoses, and we must go a step farther than merely classifying the case; we must search for the cause, and removing the cause will often be the means of curing the patient. I am quite confident that in some cases at least focal infection is a cause and should be searched for. Whether it is the cause or simply keeps the disease going, I do not know, but it should at least be removed in the course of treatment. I never like to treat a case except in association with competent internists. I disagree very distinctly with Dr. Gerber that we have no rationality for this treatment. We know and have known for years that the *x*-ray produces an atrophy in the cells of all secreting glands. The rate of this atrophy varies considerably with the glands, but if we can produce an atrophy in the cells of the gland, we will naturally decrease the secretion. In other words, we will remove part of the gland just as the surgeon removes mechanically a part of the gland. We have a better control. We can do it gradually and stop when the conditions

approach normal. I think we should never go to the point of reducing this secretion to normal, for a certain amount of atrophy will go on after we have stopped treatment. I have produced a hypothyroidism by x-ray treatment but under thyroid extract, the condition came back to normal, and the thyroid extract was discontinued. Therefore hypothyroidism is one of the dangers you should keep in mind. Outside of the treatment of fibroids of the uterus I know of nothing which has been so satisfactory.

Dr. Lichty referred to the malignant cases as not suitable for x-ray therapy. Frequently in the malignant cases the surgeon is unable to remove all of the disease, and if we know that the disease is malignant I think we ought to treat the case with the x-ray primarily; but the hard point is to diagnose between malignant and non-malignant, and so we should make the diagnosis at the time of operation. When the disease is found to be malignant use x-ray therapy and plenty of it. I have one case referred by Dr. Deaver who said, "I know I left malignant disease in there." The patient is still well eight years after treatment.

One other point: I think we ought to have Dr. Boggs give us his technique—a thing which is not settled any more than the selection of cases is settled. Briefly I do this—I am not sure it is the best: I generally treat these patients once a month, I count on keeping them under observation and treatment for at least a year with association with any additional medical treatment which has been found to be good, and the internist looks after that. I treat the patient. I try always to avoid producing an erythema, and I disagree with Dr. Gerber that it is criminal to get a tanning, these things are sometimes unavoidable, and we might be hailed into court as criminals. There are times when you cannot avoid it. These patients sometimes have sensitive skins, and we may get it. I say we should avoid it, but we must not go to the extent of calling it criminal. We must not treat the patient too long, because we may produce atrophy and telangiectases as an aftereffect. For that reason all the associated causes of the disease must be removed so as to cut down the amount of treatment given. I treat the patient usually once in four weeks and increase that interval just as soon as the symptoms approach normal or get down to a working basis, and to me the pulse is the best guide. You get earliest an increase in weight and a decrease in nervous symptoms and a decrease in pulse, and the variation in the pulse rate between the recumbent and sitting posture is a pretty good guide as to the situation. When that variation is much greater than normal you have not reached the stage when you should stop treatment. I vary the number of doses according to the severity of the symptoms and that is not based on the size of the goiter. You treat them to decrease this secretion, not to diminish the size of the goiter, and when this is bad I give treatment through more fields. Generally I treat the patient through four fields or portals of entry and by cross-firing get results with the usual filters that are used in deep therapy and I generally give 5 milliamperes through 6 millimeters of aluminum at a distance of eight inches with a nine inch spark gap.

Dr. C. F. Ball.—There is one phase of the question which has been referred to only indirectly by Dr. Holmes in his remarks regarding basal metabolism. The final analysis of thyroid treatment sifts down to a study of the amino acids. I heard Dr. C. H. Mayo express it this way—that the thyroid was the fly-wheel of basal metabolism. We have twenty odd amino acids out of which the cells effect their development. Lysin is a sulphur containing amino acid which has to be present in every combination of amino acids making up a cell's construction. The thyroxin of the thyroid secretion determines the rate amino acids are used in a cell's construction. Increase in quantity of thyroxin causes increased amino-acid activity which is measured, as Dr. Holmes says, in basal metabolism studies.

Further it is a question of the study not of thyroid activity alone but of the entire endocrine circle. Not too much is known about it, but a final analysis on thyroid treatment, whether it be medical, surgical, or x-ray, has to resolve itself into a study of amino acids in their rôle of tissue cell metabolism. I want to approve what Dr. Pfahler has just said, on the basis of what I have just mentioned, that when you go after a thyroid gland, whatever portion you want to destroy, destroy it. Avoid a skin reaction as far as possible but operate to destroy that portion of gland being treated. You do not always have to destroy the whole gland. Destroy sufficient of the gland or at least inhibit the activity of the thyroid cells of a portion or all of the gland so that the pulse rate comes down and the weight increases. Nervous symptoms are really secondary and favorably obey the inhibiting influences of a reduced metabolic activity. The patient's slowing pulse rate and increase in weight should be the controlling

factors determining amount of x-ray irradiation necessary, and not nervous manifestations.

DR. CHARLES A. WATERS.—The material for my discussion will be a short review of a few experiments I have made rather than any destructive or constructive criticism of Dr. Lichty's and Dr. Boggs's papers.

It is a well-known fact that patients suffering from exophthalmic goiter and hyperthyroidism have periods of improvement due to no definite form of therapy. These patients oftentimes show considerable improvement even while attending to their daily tasks. Rest treatment alone produces the desired result in many cases without any definite form of medication, surgery, etc., so that the question to be considered, at least in my mind, is whether the improvement noted in these cases is due to the x-ray radiation or as a result of some other form of treatment. Therefore, it is of vital importance to know what action, if any, the x-ray has upon the thyroid gland in the different affections before one can state with any degree of certainty whether the improvement is due to the x-ray treatment.

The question of the rôle of the thymus gland in the production of hyperthyroidism is still a much debated question, as Dr. Lichty mentions. If it played a definite rôle in this disease, would it not be evident? Certainly from our series of cases of exophthalmic goiter at the Johns Hopkins Hospital (about 100) in which the thymus gland was intensively radiated, very little benefit could actually be laid to the result of the x-ray exposures to the thymus. Yet the thymus being so rich in lymphoid tissue, and because of the susceptibility of this type of disease to x-ray radiation, one would naturally suppose that immediate changes would be noted.

Reviewing the literature up to 1914, Ravé shows that the experimental work done on the thyroid gland with the x-ray reveals no histological changes in the gland. Of course, this work was carried out with the old type of gas x-ray tubes, short exposures and practically no filtration; as far as I know there has been no experimental work done with intensive Coolidge tube radiation and heavy filters.

Those of you who attended the Atlantic City meeting in January, 1917, may remember the hot discussions that took place in regard to this subject. I came away determined to find out what, if any, was the effect of Coolidge tube radiation on the thyroid gland.

In collaboration with Dr. Emil Goetsch we took five dogs, and at the suggestion of Dr. Halsted we removed a very small piece of gland from each thymus, before any treatment was started, for control sections. In other words, the particular gland receiving treatment would be controlled. Five dogs were worked on, but due to the sudden departure of the Hopkins Unit for France the work was never completed and the animals died in the Hunterian Laboratory and were never autopsied.

This spring we studied two more animals in the same way and although the material from which I quote is limited yet enough evidence, I believe, was obtained to warrant a much more thorough investigation of this work. I thought it might be of interest to tell briefly what our findings were from the results of the experiments on these two dogs.

Before attempting the treatment of exophthalmic goiter or hypothyroidism with x-rays it is vitally necessary (1) that it be known what histological change takes place in the gland; (2) that the superficial or deep structures of the skin and neck be not injured by the x-rays; (3) that the effect upon the vagus, sympathetic ganglion and parathyroids be definitely known; (4) that it be known what effect on the thyroid gland is desired, that is, stimulating or inhibiting. Therefore until these points are definitely proven the work is being done not only unscientifically but with extreme danger.

With these points in view we set about to determine whether any histological change was produced by the x-ray radiation and particularly if the secretory element of the gland, the mitochondria, was affected.

The histological sections were studied by Dr. Goetsch, and I will quote briefly from his notes:

The right glands were the ones exposed, while the left side of the neck was carefully protected with heavy lead foil. The dogs were etherized, two sections made of each gland, one stained with hematoxin and eosin and the other stained with acid fuchsin methyl green for mitochondria. The Coolidge tube technique used in the treatment of these animals was uniform and consisted of the following: 5 milliamperes; 9 inch spark gap; 4 mm. glass filter; 20 cm. focal distance. The durations of the treatments varied on certain days.

Dog B. I. Small brown fox terrier.

First x-ray treatment, June 17, 1919 10 min.

Second x-ray treatment, June 27, 1919 5 min.
Third x-ray treatment, July 7, 1919 5 min.
(At this time definite epilation of hair on the right side of neck was noticed.)
Fourth x-ray treatment, July 14, 1919 5 min.

Operation July 18, 1919. Very severe dermatitis was developing when the operation was undertaken. A small piece of gland was taken from the mid-portion of both lobes, the left lobe being used as a control.

Histological Notes of the Right Lobe (Treated Side)

Hematoxin Eosin Section

The striking feature is an easily recognized protoplasm and nuclear shrinkage. The alveolar epithelium is very much atrophied and thinned out and in places appearing as a mere line. The nuclei are small, pyknotic. The colloid is present and in slightly excess amounts over the normal. The appearance generally is that of a very atrophic and inactive gland resembling in many respects the familiar defect of the thyroid parenchyma in colloid goiter.

Left Lobe Control. Acid fuchsin methyl green section.—(This gland probably received some scattered radiation.) The histological picture is that closely resembling a normal dog's thyroid. Essential features are the following: The thyroid parenchyma is made up of cuboidal and lower columnar epithelium. There is a fairly rich amount of protoplasm in the cells but the nuclei are large, round and contain abundant chromatin enclosed about in granule formation. The protoplasm of the cells carries an abundance of bright red stained mitochondria in the form of granules and short rods. This picture would indicate that the cells are functioning normally or very nearly normally. (The extreme likelihood of this gland receiving a mild amount of exposure due to imperfect screening must be taken into consideration. Had this screening been more perfect that difference might have been more striking.) The colloid is present in moderate amount, as is found in the normal gland of the neck.

Right Lobe. Acid fuchsin methyl green section.—The entire technique (histological) is precisely the same as in the control gland. Here again is a striking change as seen in the hematoxin eosin section. The alveolar epithelium is very thin and atrophic; in places the protoplasm has almost vanished and it is in many places vacuolated. The nuclei are shrunken. The chromatin is smaller in amount and many of the nuclei are contracted and pyknotic. They stain faintly and poorly generally in the methyl green. The mitochondria are present here and there in very small numbers and they appear as mere shadows and stain poorly in acid fuchsin. In many areas they are not present at all. Colloid is moderately increased in amount. There is a very striking change seen in the thyroid lobe which has been exposed to the intense radiation and, summarizing, these changes consist of a striking atrophy and shrinkage of the thyroid parenchymal cells, both on the part of the protoplasm and nuclei. There is a moderate increase in the colloid and almost complete disappearance of mitochondria as compared with the control lobe which is very rich in mitochondria. From this appearance we have reason to think that there has been a marked reduction, if not very nearly complete absence, of secretory function in the cells of the thyroid gland as a direct result of the x-ray exposures.

Dog B. II. Medium brown terrier.

First treatment, June 18, 1919...... 3 min.
Second treatment, June 20, 1919...... 3 min.
Third treatment, June 24, 1919...... 3 min.
Fourth treatment, June 30, 1919...... 5 min.
Fifth treatment, July 10, 1919...... 5 min.
(No reaction or epilation notices up to this time but no more treatments were given until about three weeks)
Sixth treatment, July 30, 1919...... 5 min.

August 5th, epilation and beginning sloughing has started and operation was undertaken this date. Small section of the right and left glands were removed precisely as in Dog B. I.

Left Lobe Control. Acid fuchsin methyl green.—This control is analogous to the control gland in the first animal. The thyroid cells are rich in protoplasm, containing the usual numbers of mitochondria for a normal dog's glands. They are stained, however, somewhat fainter than in B. I. This is due probably to a more imperfect screening, the gland lying in this larger dog in a deeper level.

Right Lobe. Acid fuchsin methyl green section.—The findings here are much the same as in the treated lobe of Dog B. I. except that the process of atrophy and shrinkage of the protoplasm and nuclei has not progressed to such a striking degree as in B. I. This is accounted for, doubtless, by the fact that in this case we were treating a much larger dog in which the thyroid gland is more deeply situated and therefore more protected against

the action of the rays. (The doses were likewise not so heavy.) Mitochondria are present in some areas as mere shadows which are very faintly stained. In other areas they are hardly discernible at all. In general the difference in appearance in the normal and treated lobes is much as in the first case, though not to such a striking degree.

There is evidence of a power to reduce the function of the thyroid gland by *x*-ray radiation, as shown histologically, and doubtless part of the failures so far have been due to insufficient exposures. But is it possible to give large enough doses to produce this reduction in function without injuring the other vital structures in the neck? It is shown conclusively that with large enough amounts of radiation a reduction in the secretory apparatus can be effected; caution as to prognosis must be the watchword.

Dr. Willis F. Manges.—I would like to have Dr. Waters tell me how much treatment he gave the dogs.

Dr. Charles A. Waters.—Replying to the question of Dr. Manges in regard to the amount of treatment given the dogs, I might say that no attempt was made to regulate the amount of dosage except to be sure that the animal received a sufficient amount of therapy. The dose was a great deal more than one could give an individual.

Dr. John A. Lichty.—The discussion has certainly been very helpful to me. One of the men who discussed my paper spoke of the amino acids and referred to there being "only 20" of them. I heard Dr. Graham Lusk say several years ago that there were only 13 amino acids, six of which we understood! So our work is rapidly increasing and we have quite a task before us if we are going into amino acids, and yet we must approach the problem from all sides.

What amazes me as an internist is the way the thyroids are treated with apparently little consideration by a certain group of men who do not appear to know the effect of *x*-ray, or the effects of traumatism, such as surgery, upon an unbalanced thyroid. We have the same example in peptic ulcer; as soon as the diagnosis is made the operation is indicated. I see from the discussion what the attitude of *this* association is in this matter and I have no fears.

From Dr. Gerber's remarks I believe we may include *x*-ray treatment under medical treatment, and that is why I feel so comfortable about the discussions this morning. It is not necessary to handle the thyroid violently, except in those conditions where there is suffocation or when other emergencies occur.

As regards the question of medical treatment, Dr. Holmes said there is no medical treatment. There is no specific drug treatment, and yet there is a place for medical treatment in these cases.

I remember having a policeman in my service who came from a dry town in Ohio. He took his position seriously, and, with the many arrests he was compelled to make, he developed a hyperthyroid condition. The first thing he did after entering the hospital was to tell me about all the noises he heard from his room—the elevator running, the nurse walking, the door squeaking, etc. He asked when he would be well. I told him as soon as he did not hear these noises. While that was an easy thing to say, it was only after the proper administration of bromides that he heard the noises less and less frequently and thus hastened his recovery. There is no specific medication, but digitalis and the bromides are frequently needed. They should be used just as crutches are used in a case convalescing from a broken leg.

I am glad Dr. Pfahler called attention to focal infection. We are apt to run away with focal infection; however, I have no doubt focal infections are a factor, but unless we take focal infections at their face value, we are going to get into trouble. They must be considered from the standpoint of their own pathology and not merely with the hope of relieving obscure symptoms and bringing about far-reaching results.

I wish to thank this Association for giving me the pleasure of meeting with you. I am thinking of the time in 1896 when I was in Berlin, when an evening's entertainment was to go to a theatre and see some one hold a book up before the audience and show how the shadow of a key may be shown through the lids. This is not twenty-five years ago and yet in this short time *x*-ray has become such a factor in medicine as to bring a group of physicians together from all over this land to discuss its helpful and healing effects. We have only begun; the possibilities of *x*-ray are wonderful, and I do not believe surgeons will have "a look-in" in cases of hyperthyroidism if the advances your Association show continue.

THE EARLY ROENTGEN DIAGNOSIS OF ULCERATIVE TUBERCULOUS COLITIS*

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INTRODUCTION

THE diagnosis of intestinal tuberculosis has long puzzled many clinicians. Without doubt a positive diagnosis can be made with a considerable degree of assurance in well developed cases. On the other hand no one has yet determined when intestinal tuberculosis begins in the course of pulmonary tuberculosis. It might be recalled that at least in 60 to 80 per cent of cases of pulmonary tuberculosis coming to autopsy, intestinal tuberculosis is present. It is of further interest to note that in 85 per cent of cases of intestinal tuberculosis the ileocecal region is involved. Again, as gastrointestinal specialists and students of pulmonary tuberculosis hesitate in most instances to make a positive diagnosis of intestinal tuberculosis, it has seemed most important that some method should be devised that could determine an early diagnosis of the complication of pulmonary tuberculosis found most frequently at autopsy.

The first point that comes to mind when tuberculosis of the intestines is discussed is the presence of tubercle bacilli in the feces. It was long held that the occurrence of tubercle bacilli in the feces indicated intestinal tuberculosis. As early as 1891 Bodo[1] proved by a study of the intestinal content at autopsy that tubercle bacilli could be found in the feces when pulmonary but no intestinal tuberculosis was present. Occult blood may be found in some instances, but is lacking in some well developed cases. Without going further into details it can be stated that many observations have shown that the laboratory diagnosis of intestinal tuberculosis is as uncertain as the clinical diagnosis.

Symptoms recognized as characteristic of this condition occur usually only in such well marked cases that diagnosis of the condition is of little avail if remediable measures are to be applied. The study of this condition has emphasized that many slight subjective symptoms hitherto regarded as of little moment indicate now the necessity for a careful intestinal study. When, for instance, any patient with early pulmonary tuberculosis begins to do badly without increase of pulmonary signs or symptoms, or, what is more important, with their decrease, an intestinal examination should be made. We feel that slight anorexia, prolonged and marked, persistent meteorism, slight abdominal discomfort or actual pain, regurgitation or vomiting of food or even slight digestive disturbances, constipation or digehea, or alternating constipation and diarrhea, slight rise of temperature, often irregular, and not connected with increase of pulmonary symptoms, may give the first suggestion of beginning intestinal involvement. Again, any patient who fails to gain weight or to make satisfactory progress requires a roentgen study of his intestinal tract.

Some years ago from our study of artificial pneumothorax we came to the conclusion that the hopeless prognosis of intestinal tuberculosis might be due to the fact that it was impossible to give the bowel sufficient functional rest by medical measures to enable it to recover. With this point in mind we discussed the problem with Archibald[2] who began and later published (1917) the results of the surgical treatment of intestinal tuberculosis. In this article Pirie,[3] who at Archibald's suggestion, studied twelve of the twenty-six cases Archibald reported, states in a short paragraph that he was disappointed in not being able to visualize the barium meal in the cecum. By careful observations

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repeated at half hour intervals from the fourth to the twelfth hour, he showed that the cecum retained none of the barium which normally should have accumulated there. When our studies were nearly completed we discovered that Stierlin[4] of Basle had noted in six such cases the absence of barium or bismuth shadows at certain times and at certain sites when normally they should have been present. Upon this data, suggesting hypermotility, Stierlin diagnosed the presence of ulceration of the large bowel at the sites mentioned and later Wilms proved these conclusions correct at operation. He had also one case of chronic non-tuberculous ulceration.

TECHNIQUE

The technique, which varies little from that usually employed in roentgen laboratories must be carefully followed in certain details. We have thought best to describe the technique more minutely under two heads, (A) The Barium Meal, and (B) The Barium Enema.

A. The Barium Meal.—The barium meal that we have used consists of four ounces of barium sulphate, one tablespoonful each of flour, cocoa and sugar; milk (sweet) to make sixteen ounces or two glasses.

The day before the patient reports at the roentgen laboratory he takes no laxative. On the morning of examination, prior to the ingestion of the barium meal, the patient is permitted to have breakfast. The barium meal is taken at an appointed time, usually about 9 A.M. The ingestion of the meal need not be observed fluoroscopically, as in none of the cases has the observation of the ingestion of the meal proved of any value.

I. *Fluoroscopic Examination.*—Six hours after the ingestion of the barium meal the patient reports for examination, having abstained from food in the meantime. Note is made at this time of any barium remaining in the stomach, the quantity of barium seen in the ileum and the character of the small bowel shadows. Particular attention is paid to the position of the head of the column, the degree of filling of the ascending colon and the outline of this portion of the bowel. At this hour the cecum and probably also the ascending colon should be well filled. However, slight variations from this hard and fast rule may be observed and are probably normal manifestations. If none of the meal has entered the cecum it is apparent at once that no pathological changes in the cecum can be definitely interpreted. In this case the patient must be observed fluoroscopically at intervals of one-half to one hour until the barium is seen within or beyond the ascending colon. This may require watching the patient from the sixth to the ninth hour.

If, on the other hand, the head of the column is well past the splenic flexure, and little or no barium remains proximal to the ileocecal sphincter, it is readily seen that the meal under observation will probably never fill the cecum. We have seen but one such case. If the head of the column is well past the splenic flexure and the cecum or ascending colon is empty and barium still present proximal to the ileocecal sphincter, the case must be observed at the short intervals previously mentioned in order to observe the character of the shadows of the cecum and ascending colon.

If a definite filling defect of the cecum or ascending colon is observed when a quantity of barium sufficient to fill them has been delivered to or has gone past these portions of the colon, there can be little question of a pathological filling defect; but even here it is advisable to re-examine the patient after one or two intervals.

We can summarize these observations under four heads: (1) The barium has not yet reached the cecum; (2) an insufficient quantity of barium has reached the cecum; (3) sufficient barium has reached and passed the cecum; and (4) practically all of the barium has passed the cecum.

Following the six hour examination, as we have said, the patient is fluoroscoped at given intervals, in any case at seven and

eight hours, in order to confirm definitely the less positive of the above findings. However, the classical changes, i.e., a definite filling defect or a ragged appearance of the cecum or of the ascending colon, plus the advanced position of the head of the column, apparently make the seven and eight hour examinations unnecessary.

The following morning, or twenty-four hours after the ingestion of the meal, the patient again reports for examination, and note is made of the barium shadows that may be present, paying close attention to the region of the ascending colon. However, the bowel is usually completely empty. At times the examination at twelve and eighteen hours will give additional information, and these may make the twenty-four hour examination unnecessary. Two or three days later the patient is examined during and following the administration of a barium enema.

II. *Radiological Examination.* Plates are taken at all examinations, usually in the prone position.

B. The Barium Enema.—The enema we have used consists of the following: Mix dry in a large bowl six ounces of gum arabic and ten ounces of barium sulphate. Add to this rapidly, stirring vigorously, forty-five ounces of hot water.

The patient reports at 10 or 11 A.M. for a barium enema. At 1 or 2 P.M. on the previous day (i.e., twenty or twenty-two hours before the enema) he has taken an ounce of castor oil. He abstains from supper, but a light breakfast is permitted on the day of the examination. A small quantity of barium (1 dram to ½ oz.) may be given with the meal just preceding the castor oil in order to detect whether any of this meal is present in the colon at the time of the barium enema. The enemas are administered in the prone or supine position. As little gravity pressure as possible is used to keep the injection moving (usually 10 to 24 inches).

I. *The Fluoroscopic Examination.*—The administration of the enema is observed fluoroscopically, note being made as to the outline of the bowel and as to the manner in which it fills. Any other unusual features attending the injection are also observed and plated. The patients may be examined in any position that will give the desired information. However, the prone and supine appear usually sufficient. During the administration the patient may complain of discomfort, or even of a sense of pain at times, which is usually only temporary. When the enema is seen to have reached the cecum, or, as in many instances, has passed through the ileocecal sphincter, the flow is shut off.

II. *The Radiographic Examination.*—At all examinations plates are made, usually in the prone position.

Normal Motility and Contour.—Before describing the various roentgen manifestations observed in patients suffering from tuberculous colitis, it seems advisable to consider roentgenographically a few points of the normal physiology and anatomy of the gastrointestinal tract. Following the ingestion of a standard barium meal the stomach usually empties itself in from three to six hours. The first evidence of barium is seen at the ileocecal sphincter in from one to three hours. The ileum empties itself in from five to nine hours. Barium is first seen in the cecum in from two to four hours, which gradually fills as it receives the intestinal contents from the ileum. In the meantime the barium column moves slowly forward until all the barium is in the colon. Six hours after the ingestion of the meal the head of the barium column is seen in the colon, usually proximal to the splenic flexure. At this hour the cecum and ascending colon are well filled and the haustra are distinctly seen. The ascending colon remains well filled from the fourth to the fourteenth hour following ingestion, and in many cases as long as thirty-six hours. Complete evacuation takes place usually in from thirty to forty-eight hours.

Pathological Hypermotility.—The first manifestation that attracted our

attention in many of the cases that were later proved to have tuberculous colitis was that in twenty to twenty-four hours the barium had been completely eliminated. This hypermotility was usually found only in those cases that had the most suggestive clinical picture. Thinking that this hypermotility might be the result of an existing tuberculosis somewhere in the intestinal tract an effort was made to determine its location. At first it was thought that this hypermotility might be the result of the influence of a laxative. However, in the succeeding cases patients were instructed to abstain from any laxatives for at least thirty-six hours prior to the roentgen examination. It may be mentioned here, however, that only a few of the positive and doubtful cases used laxatives or oils, as their bowels were usually loose. Upon re-examining some of the earlier cases who previously may have taken laxatives it was noted that there still existed a definite hypermotility.

Close attention was paid to the different parts of the small and large intestine with regard to the physiology and anatomy of the respective parts, with the result that the cecum and ascending colon fell under suspicion. Examining patients at short intervals from the sixth to the eighth hour, it was noticed that the cecum and possibly the ascending colon, and in some cases other portions of the colon distal to these sites, refused to retain barium to their full capacity, that is to say, they showed a greater tendency to discharge barium than to retain it any length of time. In many instances, in fact, so little

FIG I. CASE 7348. SIX HOURS, PRONE.

Note ileal stasis; no barium shadows have reached cecum. Referred for pulmonary tuberculosis, far advanced. Definite symptoms of intestinal tuberculosis. Site of x-ray lesion, diagnosis of tuberculous colitis (site not determined) made on ileal stasis at six hours plus practically complete absence of barium shadows at twenty-four hours. At operation, ascending and transverse colon tuberculous. Operation, excision of diseased area. Post-operative death.

FIG. 2. SAME CASE AS FIG. I. 24 HOURS, PRONE.

Hypermotility, only faint traces of barium remain.

barium was seen in the cecum or ascending colon at different examinations that it was not possible to visualize a well-filled cecum or ascending colon. The character of the shadows in these portions of the bowel was so irregular at all times that we inferred that these portions of the colon were, more or less continually, in a state of spasm or collapse, and as soon as material was delivered to these portions, it was largely or completely eliminated. Consequently it was impossible to catch these portions of the colon well filled. In other cases different manifestations existed. At six or seven hours, instead of seeing the cecum filled, no barium had passed the ileocecal sphincter, even though the stomach was entirely empty. All the meal was seen in the terminal ileum. A subsequent examination, one hour later, might reveal the head of the column distal to the middle of the transverse colon with still nothing in the cecum or ascending colon, and at twenty-four hours the bowel would be either entirely empty or the entire meal found in the sigmoid and rectum. An illustrative case can be seen in Fig. 1. Six and seven hour examination, stomach empty, head of the column at the ileocecal sphincter. Twenty-four hours, all barium has been eliminated. It is quite possible that the ascending colon did contain barium for a longer or shorter period of time, some time between the sixth and twenty-fourth hour. However, certain cases

FIG. 3. CASE 7162. SIX HOURS, PRONE.

Note spastic ragged appearance to cecum and ceco-colon. Hypermotility, head of column in rectum. Referred for pulmonary tuberculosis. Hyperacidity, occasional vomiting, frequent regurgitation of food, marked constipation. Cecum palpable, possibly thickened. Site of *x*-ray lesion, cecum and ceco-colon, indicated by lines. At operation cecum and ceco-colon tuberculous. Operation, excision of diseased area. Condition one year after operation, apparently complete recovery.

FIG. 4. CASE 7213. SIX HOURS, PRONE.

Spastic, ragged appearance of ascending and first portion of transverse bowel. Hypermotility; head of the column in sigmoid. Referred for pulmonary tuberculosis. Occasional diarrhea, stools foul, slight abdominal discomfort. Site of *x*-ray lesion, ascending and probably first portion of transverse colon (indicated by lines). At operation ascending and first half of transverse colon tuberculous. Operation, appendectomy. Condition twelve months after operation, no symptoms, gain of thirty pounds. Twenty-four hour examination, bowel entirely empty.

revealed no appreciable amount of barium, at least in the cecum, at the times when they were examined.

Another class of cases presented slight variations from the course described above. At six hours the head of the column was in the sigmoid or rectum, with the large bowel well filled from this point as far back as the suspected portion, in which there might be little or no barium. The ileum was usually fairly well filled. (See Fig. 4.) Re-examination of these patients at short intervals would reveal the ileum emptying or emptied. However, no barium remained in the cecum or ascending colon, the areas which were under suspicion.

In some cases while palpating the abdomen in the region of the ascending colon, in an effort to fill this portion of the bowel, which may have been only partially filled, we were decidedly unsuccessful, and were surprised to find what little barium may have been in the cecum move forward rather rapidly to some distal portion of the colon. The *vis-a-tergo* could apparently be excluded.

Some of the cases examined earlier in the series were brought back for complete re-examination to see if the various pathological manifestations could again be observed. All of the cases which were regarded as positive at the first examination were confirmed at subsequent examinations.

FIG. 5. CASE 7588. SIX HOURS, PRONE.

Note filling defect of ascending and first portion of transverse colon. Referred for pulmonary tuberculosis, moderately advanced. Definite abdominal symptoms with pain. Site of x-ray lesion ascending and first portion of transverse colon. At operation ascending and first half of transverse colon tuberculous. Twenty-four hour plate, bowel entirely empty.

FIG. 6. SAME CASE AS FIG. 5. ENEMA PLATE, PRONE.

Note filling defect of ascending and first portion of transverse colon.

FILLING DEFECTS.—Since the cecum or ascending colon was apparently the site of the tuberculous focus, and recalling the physiology of these portions of the bowel, it seemed as though some importance could be attached to the phenomena observed at these sites. Normally these portions of the bowel accept and retain

for varying lengths of time considerable fecal matter, which usually fills them and reveals their smooth contour. In cases with tuberculous colitis, proved at operation, smooth haustration was absent and the bowel had a distinctly ragged outline. A description of the filling defect is difficult, and the reader is referred to Figs. 8, 3, and 5 as good illustrations of this manifestation. At different examinations between the fifth and ninth hour this filling defect would vary, but was always present.

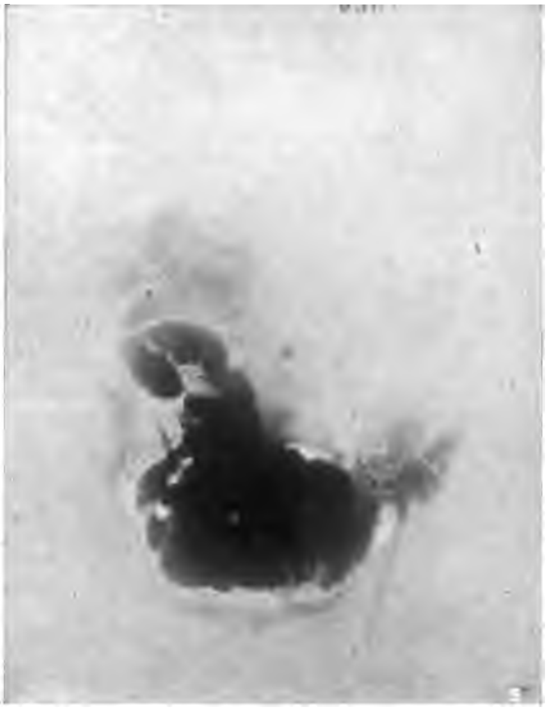

FIG. 7. CASE 9307. SIX HOURS, PRONE.

Spastic, ragged appearance to ascending and probably a portion of the transverse colon. Hypermotility, head of column in the rectum. Referred for pulmonary tuberculosis. Definite abdominal symptoms with diarrhea and pain. Site of x-ray lesion, ascending colon and probably portion of transverse (indicated by lines). At twenty-four hours, bowel entirely empty.

The question arose immediately, could other conditions produce this combination, i.e., hypermotility and filling defect, and their peculiar accompanying features? A few cases were observed that had taken laxatives (usually castor oil) the night before the barium meal was given. Particular attention was paid to the cecal region and the variation in the motility of the bowel, and while the latter was increased perceptibly (in some instances the bowel was empty in twenty-four hours), the spastic or ragged outline of the ascending colon did not occur. This portion of the bowel may have been incompletely filled at different examinations, but the outline of the haustra was usually fairly smooth. The most notable feature in these cases was the tendency of the proximal

FIG. 8. CASE 5135. SIX HOURS, PRONE.

Note filling defect (spasm) in cecal region. Patient referred for pulmonary tuberculosis. Abdominal symptoms, constipation. Site of x-ray lesion, cecum and ceco-colon. Twenty-four hour examination revealed bowel empty as far as rectum.

portions of the colon, particularly the ascending colon, to retain barium a reasonable length of time. This, apparently, is just the contrary of what occurs in patients having tuberculous colitis.

A few cases of acute and habitual diarrhea were examined, but in none were there any definite filling defects. There was

a rapid emptying of the bowel, however; in some cases complete emptying occurred in less than twenty-four hours.

On going over the literature we found an article by Jordan[5] in which he studied the motility of the bowel in various conditions. He describes and illustrates in this article a number of cases of colitis and diarrhea, but in none of these were we able to see the manifestations we had observed in cases suffering from tuberculous colitis. His illustrations reveal the cecum usually well filled and with smooth haustrations even though in a number of instances there was definite history of diarrhea. Such findings taken together with the cases suffering from habitual diarrhea that we have observed made us feel reasonably sure that the cecum or ascending colon did not present in these conditions the picture seen in tuberculous colitis. Other articles by Imboden[6] and Spriggs,[7] illustrate the findings in many cases of chronic appendicitis, and here again we failed to find the picture we have described. In fact, in practically all the illustrations shown the cecum was invariably well filled. A review of George and Leonard's[8] book also helped to confirm the standards laid down for tuberculous colitis.

Study of the Barium Enema.—The enema is seen to move slowly cecalward, usually in an unbroken column, until it reaches the diseased portion of the colon, where it may be held up temporarily. At other times gas in the bowel interferes with its progress. At this time a slight increase of gravity pressure or mild manipulation will usually overcome the obstruction. When the barium entered the diseased portions of the colon, certain manifestations were observed similar to those seen following

FIG. 9. SAME CASE AS FIG. 8. ENEMA PLATE, PRONE.

Note filling defect in cecum and ceco-colon. Repeated spasm of this portion of the bowel was observed following injection of enema.

FIG. 10. SAME CASE AS FIG. 8. SECOND EXAMINATION, ONE MONTH LATER. FOUR HOURS, PRONE.

Note filling defect in ascending colon region, particularly the cecum.

the ingestion of a meal. The enema filled the diseased portion (usually the cecum and ascending colon) very slowly and in many instances in a very irregular fashion. It seemed in many of the cases that these portions of the bowel were in a state of spasm or collapse and that the enema found difficulty in gaining entrance. However, it would eventually fill them, only to be forced out a few seconds later by a spasm of this portion of the colon. This sequence of events, filling and emptying, might be repeated often in the next few minutes. In all of the cases manifesting the above features, which came to operation, cecal ulceration (tuberculous) was found. However, in one or two of the cases in which the bowel was completely filled, tuberculous colitis was present. It is difficult, therefore, to place a definite value on the spasm which at times follows the injection of the enema. We are at present studying a number of normal cases to note if such a spasm occurs. The presence of a spasm seems in diagnosis to be of more value than its absence.

ANALYSIS OF RESULTS

In all, 175 cases have been examined roentgenologically. Of these 44 were positive, 32 doubtful, and 99 negative for tuberculous colitis.

PULMONARY TUBERCULOSIS

		Operated upon
Positive Cases, 44		
Incipient	4	2
Moderately adv.	19	4
Far advanced	21	8
Doubtful Cases, 32		
Incipient	3	0
Mod. advanced	22	1[a]
Far advanced	7	0
Negative Cases, 99		
Neg. or Doubtful	12	0
Incipient	15	0
Mod. advanced	70	0
Far advanced	2	1[b]
Total	175	16

About fifty cases have been examined for other physicians, and of these twelve have been operated on and are included in the following table, through the kindness of Doctors R. C. Paterson, R. M. Brown, S. F. Blanchet and C. C. Trembley:

PULMONARY TUBERCULOSIS
CASES OPERATED UPON, 28

		Operative Findings Positive	Operative Findings Negative
Positive by x-ray, 22			
Incipient	2	2	......
Moderately advanced	12	12	......
Far advanced	8	8	......
Doubtful by x-ray, 5			
Moderately advanced	4	3	1[a]
Far advanced	1	1	......
Negative by x-ray, 1			
Far advanced	1	......	1[b]
Total	28	26	2

On comparing the operative findings with the roentgenological interpretation it was found that many of the foregoing cases presented more extensive ulceration than was indicated by the plate or fluoroscope. However, in the remainder of the cases the changes found at operation tallied very closely with what was suspected at the roentgenological examination. The reason for this discrepancy in operative and plate findings is probably due to the fact that those portions of the bowel distal to the middle of the transverse colon could not be studied with any degree of certainty at the six and twenty-four hour examinations. After fecal matter had passed, say, the hepatic flexure, it was likely to remain such a short length of time in any portion of the bowel distal to this site that it was impossible to interpret any definite hypermotility or filling defect. Again, bearing in mind the physiology of these portions of the bowel, particularly those distal to the middle of the transverse colon, it can be readily understood that it might be impossible to get any roentgenological evidence suggesting lesions in these parts. However, examinations at other times, between the sixth and twenty-fourth hour, might give us some information on this point. Force of circumstances did not permit us to do this in many instances.

The question of diagnosis of tuberculous enteritis has been purposely omitted from this article, and as far as we are aware no

a. This case presented a filling defect in the transverse colon and some hypermotility, which emphasizes the danger of interpreting filling defects beyond the hepatic flexure.
b. We believed that this patient had tuberculous enteritis, and at operation this was found, while the colon was normal.

work has been done that establishes definitely the diagnosis of tuberculosis of the small intestine. However, consideration should always be given to this portion of the bowel if operative measures are to be suggested. At present we have the question of the diagnosis of tuberculosis of the small intestine in mind and are working upon it.

A number of cases in the preceding tables have been classified as "doubtful," which, from the clinical side, presented all the symptoms of intestinal tuberculosis and were unlike those cases that were classified as "positive." The reason for classifying these cases roentgenologically as "doubtful" is based upon the fairly marked changes in the proximal portions of the large bowel, particularly the cecum and ceco-colon. At some of the examinations the cecum and ceco-colon did not present the usual pouchlike appearance expected. The width of the bowel shadow at these sites was narrower than normally seen and the margins of the shadows were somewhat ragged. At twenty-four hours in these cases a fairly definite hypermotility might have been observed. At different times between the six and nine hour examinations this ragged appearance of the cecum persisted. However, typical spasm as observed in the positive cases was never seen. Had we examined these patients at other times the spasm or filling defect might have been present. Possibly the most characteristic or suggestive finding in these cases was the lack of smooth haustration usually seen in normal individuals. Some of these cases revealed a distinctly narrowed appearance to a small portion of the bowel, usually the cecum, which normally is found to have a greater width than portions distal to it. Following the injection of an enema this narrowing persisted. Some of these cases have been operated upon and have been found to be

FIG. 11. SAME CASE AS FIG. 8. SECOND EXAMINATION. FIVE HOURS, PRONE.

Note persistent filling defect in ascending colon.

FIG. 12. SAME CASE AS FIG. 8. SECOND EXAMINATION. SIX HOURS PRONE.

Note persistent filling defect in ascending colon. Twenty-four hour plate; bowel entirely empty.

tuberculous. The site of the ulceration commonly agreed with the atypical filling defect of the cecum or ascending colon. We would like to state that the absence of a definite hypermotility and filling defect or spasm does not necessarily indicate the absence of a tuberculous colitis. The presence of a beginning hypertrophic colonic tuberculosis may cause not only a lack of emptying, but even a retention at the end of twenty-four hours.

CONCLUSIONS

1. Tuberculous colitis may be diagnosed positively, clinically, in many well advanced cases.

2. In many early cases a positive diagnosis by clinical or laboratory methods cannot be made.

3. This roentgenological method has enabled a diagnosis to be made positively in many cases where otherwise it would have remained uncertain.

4. The roentgenological diagnostic criteria are filling defects and hypermotility.

5. Emphasis must be placed on the fluoroscopic examination, but some plates must be taken in each case to reveal and to record certain filling defects.

POSITIVE CASES

Case	Pulmonary Disease: Pulmonary Condition	Pulmonary Disease: Roentgen Classification	Pulmonary Disease: Tubercle Bacilli	Pulmonary Disease: Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows: Il	Ce	HF	TC	DC	R	Spasm	Twenty-Four Hour Examination Barium Shadows: Ce	HF	TC	DC	R	Filling Defect Enema Plate	Abdominal Symptoms
4909	FA	3	+	36	....	Fav.	+	Sl	..	..	..	..	Cecum	o	o	o	+	+	......	2, 5,
5045	FA	3	+	40	....	Fav.	+	Sl	..	..	..	..	Cecum	o	o	o	o	o	Ce-HF	7
6867	FA	..	+	60	....	Fav.	o	Sl	+	+	+	..	Cecum	No	Exa	min	atio	n		
7162	I	2	o	3	....	Unfav.	o	Sl	+	+	+	..	Cecum	Sl.	Sl	Sl	Sl	Sl	......	3, 5, 6, 7, 8
7348	FA	3	+	30	....	Unfav.	+	..	..	..	..	..	.....	o	o	o	Sl	Sl	......	2 and 5 questionable 7 and 8 persistent
7366	FA	..	+	36	Nephritis	Unfav.	+	Sl	..	..	..	..	Cecum	No	Exa	min	atio	n		2, 3, 5, 7, 8 persistent
7514	FA	..	+	14	....	Unfav.	+	Sl	+	+	+	..	Cecum	o	o	o	Sl	+	......	3 severe, 7
7521	MA	3	+	24	....	Fav.	+	Sl	+	+	+	..	Cecum	o	o	o	o	o	Ce?	1, 3, 6
7541	FA	..	+	8	....	Unfav.	+	+	o	+	+	..	HF	o	o	o	o	Sl	......	1, 3, 4, 6, 7
7561	MA	..	..	12	Larynx	Unfav.	+	Sl	+	+	+	..	Cecum	o	o	o	o	o	o	1 persistent
7607	FA	..	+	13	....	Unfav.	Sl	+	o	o	o	+	Ce-TC	o	o	o	o	+	......	1, 4
7724	FA	..	+	6	Elbow	Unfav.	+	+	+	o	o	+	TC	o	o	o	o	o	o	3, 5, 8, 1 and 7 persistent
7739	MA	3	+	10	....	Fav.	+	?	..	..	..	..	Ce?	o	o	o	o	+	o	1 and 6 alternately
7805	MA	..	+	14	....	Unfav.	+	Sl	o	o	o	S	Ce	o	o	o	o	+	......	2, 3, 4, 5, 8
7806	I	3	+	24	....	Fav.	+	+	o	o	+	..	Ce	o	Sl	o	o	+	o	1, 4, 7
7822	MA	..	o	18	....	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	+	+	Ce	1, 2, 5, 3 severe
7875	FA	..	+	9	....	Unfav.	+	..	..	..	..	..	.....	o	o	o	o	o	......	1, 3
7901	FA	3	+	36	....	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	Ce	1
5075	MA	2	+	9	....	Fav.	+	+	+	+	+	–	Ce	Sl	Sl	o	o	Sl	Ce	1
8544	FA	3	+	6	Larynx	Unfav.	12	Ho	ur	Exa	m.		.....	o	o	o	o	+	Ce ?	6, 7
8593	MA	3	–	12	....	Unfav.	+	+	..	..	..	..	Ce	+	+	o	o	+	......	1, 3, 8, –7 severe
8873	I	3	–	14	Appendectomy	Fav.	+	+	S	S	+	..	Ce	o	o	o	o	+	Ce ?	1, 2, 3, 7, 8
7093	FA	3	+	36	....	Fav.	+	+	+	+	+	..	Ce-TC	o	o	o	o	..	Ce-TC	1 and 6 alternately
7733	FA	3	+	36	Larynx, ear rectal abscess	Unfav.	+	S	..	..	..	..	Ce	o	o	o	o	o	......	1, 3, 4, 8
8985	MA	..	+	12	....	Fav.	+	..	..	..	..	..	Ce	Sl	+	..	..	..	......	3, 6, 8
5058	MA	3	+	10	....	Fav.	+	+	+	+	+	..	Ce	o	o	o	o	o	Ce	1, 2, 3, 4, 8
9307	FA	3	+	..	....	Fav.	+	o	+	o	+	+	Ce	o	o	o	o	o	......	1, 4, –7 marked
5096	FA	3	+	7	....	Fav.	o	o	o	o	+	+	.....	o	o	o	o	o	Ce ?	1, 2, 4, 8
4876	FA	3	+	5½	....	Fav.	+	+	+	+	..	..	Ce	Sl	+	+	+	+	......	4, 7
9508	FA	3	+	..	....	Fav.	+	Sl	o	Sl	Sl	+	Ce-HF	o	o	o	o	o	......	1, 2, 3, 5, 7
4428	MA	3	+	37	....	Unfav.	+	o	+	+	..	..	Ce ?	o	o	+	+	o	......	1, 2, 3, 4
5135	MA	3	+	6	....	Fav.	+	Sl	+	+	..	..	Ce	o	o	o	o	+	Ce	6
9561	MA	3	+	19	Isch.-rectal abscess	Fav.	+	+	+	+	+	+	Ce-HF	o	o	o	o	+	......	1, 7
5178	MA	3	o	18	Isch.-rectal abcess	Fav.	+	Sl	Sl	o	+	+	Ce	o	o	o	o	+	......	6
5143	I	3	+	7	....	Fav.	+	o	o	o	o	Sl	Ce	o	o	o	o	+	Ce	4, 6
9676	FA	..	+	31	....	Fav.	+	..	..	..	..	..	.....	o	o	o	o	+	......	2, 3, 8, 1 and 6 alternately
9701	FA	3	+	10	....	Fav.	+	+	+	+	+	..	Ce	o	o	o	o	o	......	1, 2, 3, 4, 5, 7, 8
5200	MA	3	+	6	....	Fav.	+	o	Sl	..	..	..	Ce	o	o	o	o	o	......	
5070	MA	3	+	8	....	Fav.	+	+	+	+	+	+	Ce	o	o	o	o	+	......	4
9890	MA	3	+	22	....	Fav.	+	+	+	+	+	..	Ce	o	o	o	o	o	......	1, 3, 4, 8
9907	MA	3	+	120	....	Fav.	+	Sl	Sl	+	+	+	Ce-HF	o	o	o	o	+	......	1, 8
10090	MA	3	+	14	....	Fav.	+	Sl	o	o	o	+	Ce	o	o	o	o	o	......	1, 2, 3, 7, 8
10092	FA	..	+	9	....	Fav.	+	Sl	+	+	+	+	Ce	o	o	o	o	o	......	2, 3, 8
10170	MA	..	+	6	Isch.-rectal abscess	Fav.	+	Sl	Sl	o	+	..	Ce-HF	o	o	o	o	o	......	1, 2, 5, 7, 8

DOUBTFUL CASES

Case	Pulmonary Disease				Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months			Il	Ce	HF	TC	DC	R	Spasm	Ce	HF	TC	DC	R		
4775	MA	3	+	30	....	Fav.	+	+	+	..	..	..	.....	o	o	o	o	+	......	1, 2, 3, 4, 5
4780	MA	3	+	54	....	Fav.	+	+	+	..	..	..	.....	o	o	o	o	o	......	6
4815	I	1	o	42	....	Fav.	+	+	+	+	..	..	Ce ?	o	o	o	+	+	......	4, 7
4881	MA	3	+	30	....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	+	Cecum	2, 3, 4, 6, 8
4902	MA	2	+	3	....	Fav.	+	+	+	+	..	..	Ce ?	Sl	Sl	Sl	Sl	+	......	2, 4, 5, 7
4908	MA	2	o	7	....	Fav.	+	+	+	+	+	+	.....	o	o	o	+	+	......	2, 3, 4
4948	MA	Pb	o	36	....	Unfav.	+	+	+	..	..	..	.....	o	o	o	o	+	......	2, 4
4955	MA	2	+	2	....	Fav.	+	+	..	..	..	..	.....	o	o	o	o	+	......	4, 6
5000	MA	3	+	24	....	Fav.	+	+	+	+	..	..	.....	o	o	o	o	+	......	4, 6, 7
7522	FA	..	+	36	Larynx	Unfav.	+	+	+	+	..	..	Ce ?	o	o	o	Sl	+	......	1 and 6 alternately
7529	FA	3	..	60	Appendectomy	Unfav.	+	Sl	Sl	..	..	..	Ce ?	Sl	o	o	+	+	......	1, 3, 4, 7, 8
7722	MA	3	+	18	Larynx	Fav.	+	+	+	+	..	..	.....	o	o	+	o	+	o	1
7863	MA	..	+	24	Larynx	Fav.	+	Sl	o	o	+	..	.....	+	+	+	o	Sl	......	
7877	FA	3	+	9	Larynx	Unfav.	+	..	..	..	..	..	.....	+	+	+	..	..	......	
8563	MA	3	+	42	....	Fav.	12	Ho	ur	Ex	am.		Ce ?	+	+	+	o	+	o	1
4544	MA	Pb	+	10	Larynx	Fav.	o	+	+	+	..	..	Ce ?	Sl	+	+	+	+	......	1, 3, 4
8942	MA	3	+	12	Otitis Med.	.....	+	+	+	+	Sl	..	.....	o	o	+	o	Sl	......	8
9206	MA	3	+	18	....	Fav.	+	+	+	+	..	..	Ce ?	o	+	+	+	o	......	6, 8
7493	FA	3	+	20	Larynx	Fav.	+	Sl	..	..	..	..	.....	Sl	Sl	o	Sl	Sl	......	2, 3, 8
7923	MA	3	+	48	Nephritis	Fav.	+	+	+	+	+	..	.....	Sl	+	+	o	o	Cecum	1 and 6 alternately 1, 3, 7, -8 marked
5080	I	2	+	16	....	Unfav.	+	+	+	+	+	..	.....	o	o	o	o	o	......	1, 2, 3, 8
4089	MA	3	+	115	....	Fav.	+	+	o	+	..	..	Ce?	o	o	+	+	+	......	4, 6
8976	I	o	2	22	....	Fav.	+	+	+	..	..	..	Ce ?	+	+	+	+	+	......	3, 7
5046	FA	3	+	30	....	Fav.	+	..	..	..	..	..	.....	+	+	+	+	+	Ce ?	2, 6, 8
9532	MA	3	+	180	....	Fav.	+	+	+	+	..	..	Ce ?	Sl	Sl	Sl	Sl	+	......	
9602	MA	3	..	13	....	Fav.	+	Sl	Sl	Sl	..	..	Ce ?	o	o	o	o	Sl	......	3, 4, 7
5159	MA	3	+	4	....	Fav.	+	o	+	+	..	..	Ce ?	o	o	o	o	+	......	
9776	MA	3	o	17	....	Fav.	+	+	+	+	..	..	Ce ?	o	o	o	o	o	......	1, 7, 8
5207	FA	3	+	16	....	Fav.	+	+	+	..	..	..	Ce ?	o	o	o	+	+	Ce	
5165	MA	2	+	12	....	Unfav.	+	+	+	+	+	+	Ce ?	o	o	o	o	o	......	4
10126	FA	..	+	38	....	Fav.	+	..	..	..	..	..	......	+	+	+	+	+	......	6
9315	FA	3	+	24	....	Fav.	+	+	..	..	..	..	TC ?	+	+	+	+	+	......	

NEGATIVE CASES

Case	Pulmonary Disease				Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months			Il	Ce	HF	TC	DC	R	Spasm	Ce	HF	TC	DC	R		
4716	MA	1	+	18	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	4
4743	MA	Pb	+	21	....	Unfav.	+	+	+	..	..	..	o	+	+	+	+	..	......	2, 5, 6, 7, 8
4768	MA	1	o	13	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	..	......	2, 4, 5, 6, 7
4773	MA	1	—	8½	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	2, 4, 6, 7
4774	MA	Pb	—	48	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	2, 5, 6, 7
4777	MA	Pb	+	42	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	1, 3, 4
4785	MA	Pb	—	8	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	6
4787	D	Pb	o	18	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	1, 2, 4, 5, 7
4803	MA	1	—	10	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	4, 6
4810	MA	2	+	12	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	4, 6
4814	D	Pb	o	24	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	
4817	D	Pb	o	36	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	4
4818	MA	1	o	9	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	2, 4, 6
4783	MA	2	+	8	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	2, 4, 5
4824	I	Pb	o	24	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	..	......	4, 6
4827	MA	3	+	6	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	2
4829	D	Pb	o	6	....	Fav.	+	..	..	..	..	..	o	+	+	+	+	+	......	2, 4, 6, 7
4839	MA	2	+	16	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	4, 6
4846	MA	2	+	27	....	Fav.	+	+	+	+	..	..	o	+	+	..	..	..	......	2, 3, 5, 8
4852	MA	1	o	14	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	2, 4, 5, 6
4878	MA	1	+	5½	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	6
4887	MA	Pb	o	4	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	2, 4, 6
4894	D	Pb	o	16	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	2, 4, 5, 6
4905	N	Pb	o	65	....	Fav.	+	+	+	..	+	..	o	+	+	+	+	+	......	4
4895	MA	3	+	6	....	Unfav	+	+	+	..	..	..	o	+	+	+	+	+	......	2, 5, 6
4907	MA	1	o	72	....	Fav..	+	+	+	..	..	..	o	+	+	+	+	+	......	2, 4, 5, 6, 7
4916	MA	Pb	—	6½	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	

NEGATIVE CASES (Cont.)

Case	Pulmonary Disease: Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows: Il	Ce	HF	TC	DC	R	Spasm	Twenty-Four Hour Examination Barium Shadows: Ce	HF	TC	DC	R	Filling Defect Enema Plate	Abdominal Symptoms
4920	MA	2	+	30	....	Fav.	+	+	+	..	..	..	o	+	+	+	..	..	......	4, 6, 8
4921	N	Pb	o	18	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	2, 6, 7
4922	MA	2	o	20	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	
4940	MA	1	o	10	....	Fav.	+	+	+	..	..	..	o	+	+	..	..	..	......	2, 4, 6
4942a	MA	2	+	19	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	4, 6
4943	MA	2	+	4	....	Unfav	+	+	+	..	..	..	o	+	+	+	+	+	......	2, 4
4953	MA	3	+	14	....	Fav.	+	+	+	..	..	..	o	Sl	Sl	+	o	+	......	
4978	MA	1	o	120	Addison ?	Unfav.	+	+	+	..	..	..	o	+	+	+	..	..	......	2, 4, 6
4998	MA	2	+	4	....	Fav.	Sl	+	+	+	..	..	o	+	+	o	o	+	......	2, 3, 4, 5, 6
5007	MA	3	+	72	....	Fav.	+	+	+	+	..	..	o	Sl	Sl	+	+	..	......	4, 7
5024	I	Pb	o	72	....	Fav.	+	+	+	+	..	..	o	+	+	+	o	o	......	
5042	MA	1	o	96	....	Fav.	+	+	+	..	..	..	o	+	+	+	..	..	......	2, 4, 6, 7
5080	I	1	+	12	....	Unfav.	+	+	+	..	..	..	o	o	+	+	+	..	......	
7505	D	Pb	NS	48	....	Fav.	Sl	+	+	..	..	..	o	Sl	+	+	o	o	......	3, 6
7681	MA	2	+	11	....	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	
7770	N	?	o	1	....	Fav.	Sl	+	+	Sl	Sl	..	o	Sl	+	Sl	o	+	......	3
7977	I	2	NS	6	Epidid. ?	Fav.	+	+	+	..	..	..	o	+	+	+	+	+	......	3
5037	MA	2	o	6	....	Fav.	+	+	+	..	..	..	o	+	+	+	o	+	......	2, 4, 5, 7
8526	I	2	o	14	....	Fav.	+	+	+	+	..	..	o	+	+	+	o	+	......	8
8551	MA	..	+	22	....	Fav.	18	Hour		Exam.		only		+	+	+	+	+	o	1
8559	MA	2	+	42	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	o	3
8792	MA	1	+	8	....	Fav.	+	+	+	..	..	..	o	+	+	o	o	+	......	8
8913	MA	2	+	18	....	Unfav.	+	+	+	+	+	Sl	o	..	..	..	..	..	......	2, 5, 6
9088	MA	2	+	156	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	1, 4
9207	I	..	o	60	....	Unfav.	+	+	+	..	..	..	o	+	+	+	o	Sl	......	8
9192	MA	3	+	6	....	Fav.	+	+	+	..	..	..	o	+	+	+	Sl	..	......	8
9141	I	..	+	96	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	1, 2, 3, 8
9106	MA	..	+	120	....	Fav.	+	+	+	+	+	..	o	+	+	+	+	+	......	4, 7
9105	MA	2	..	120	Effusion	.....	+	+	+	+	..	..	o	Sl	Sl	o	o	+	......	1, 2, 3
4822	MA	1	+	5½	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	
5065	MA	2	+	18	....	.....	+	+	+	..	..	..	o	+	+	+	+	+	......	4
9227	MA	2	+	84	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	4, 8
9228	MA	2	+	24	....	Fav.	+	+	+	+	..	..	o	+	+	+	+	+	......	4, 6
4864	MA	2	+	24	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	+	......	3, 4, 5, 6
4943	MA	2	+	16	....	Unfav.	+	+	..	..	..	..	.....	+	+	+	+	+	......	4
4895	MA	3	+	10	....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	3, 6
5042	MA	2	o	40	....	Fav.	+	+	+	..	..	..	.....	+	+	o	o	+	......	4
8779	MA	3	+	20	....	Fav.	+	+	..	..	..	..	.....	+	+	+	+	+	......	
5110	D	3	o	60	....	Fav.	+	+	..	..	..	..	.....	+	+	+	+	+	......	2, 3, 4, 6
6089	MA	3	+	100	....	Fav.	o	+	+	+	+	..	.....	+	+	+	+	+	......	4
4675	MA	3	+	36	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	..	......	3, 4
4153	MA	2	o	36	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	..	......	4
5065	MA	3	+	20	....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	4
5149	MA	3	+	65	....	Fav.	+	+	+	+	+	..	.....	+	+	o	+	+	......	3, 4
5142	MA	Pb	+	22	....	Unfav.	+	+	+	+	+	..	.....	+	o	+	o	+	......	2, 3, 4, 5
5130	I	3	o	8	....	Unfav.	+	+	+	..	..	..	.....	+	+	o	+	+	......	3, 7
5167	I	3	+	12	....	Fav.	+	+	+	..	..	..	.....	o	+	o	+	+	......	2, 4, 6
5116	MA	1	o	100	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	+	......	4
5183	D	Pb	o	120	....	Fav.	+	+	+	+	..	..	.....	Sl	Sl	o	o	o	......	2, 4, 8,– 1 for ten years
5136	MA	3	+	21	....	Unfav.	+	+	+	+	..	..	.....	o	o	+	+	+	......	4, 6
5134	MA	3	+	76	....	Unfav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	3, 4, 5, 6, 7
9675	MA	o	+	24	....	Fav.	+	+	+	..	..	..	.....	+	+	+	o	+	......	4, 6, 7
9684	MA	3	+	26	....	Fav.	+	+	..	..	..	..	.....	+	+	+	+	+	......	1, 2, 3, 4, 5, 7, 8
9700	MA	2	o	24	....	Unfav.	+	+	+	+	..	..	.....	o	o	+	o	o	......	
5186	I	3	o	8	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	+	......	
5203	I	Pb	+	24	....	Unfav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	4, 5, 7, 8
9756	MA	3	+	8	....	Fav.	+	..	..	..	..	..	.....	+	+	+	+	+	......	
9135	FA	3	+	12	....	Unfav.	+	+	+	..	..	..	.....	+	+	+	+	o	......	3, 6
5150	D	Pb	o	14	....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	4
5187	MA	3	+	12	....	Fav.	+	+	+	o	+	..	.....	+	o	o	o	o	......	o
5204	MA	1	o	122	General Adenitis	Unfav.	+	+	+	..	..	..	.....	+	o	o	o	+	......	3, 4, 5, 6, 8
9837	MA	3	+	24	....	Fav.	+	+	..	..	..	..	.....	+	+	+	+	+	......	6, 1, 2, 3, 4, 7, 8
4902	MA	2	+	6	....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	o	......	2, 4, 5, 7
5125	I	2	+	5	....	Fav.	+	+	+	+	..	..	.....	o	o	+	+	+	......	4
5194	MA	3	+	45	....	Unfav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	3, 4
5216	MA	3	+	120	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	+	......	4, 7
5180	I	3	+	7	....	Fav.	+	+	+	+	..	..	.....	o	+	+	+	+	......	7
10131	I	Pb	o	6	....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	+	......	3, 4, 5, 7, 8
10173	I	..	..	157	Peritonitis	Fav.	+	..	..	..	..	..	.....	+	+	+	+	+	......	3, 6, 7
10186	MA	—	+	96	....	Fav.	+	+	o	+	..	..	.....	+	+	+	o	+	......	
10229	MA	1	+	108	....	Fav.	+	+	+	..	..	..	.....	+	+	+	..	..	......	4, 6, 8
10414	FA	3	..	60	....	Fav.	+	+	+	+	..	..	.....	+	+	+	+	+	......	2, 4, 6, 7, 8

CASES OPERATED UPON

Case	Six Hour Examination Barium Shadows						Site of X-ray Lesion and Spasm	Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Sites Found to Be Tuberculous at Operation
	Il	Ce	HF	TC	DC	R		Ce	HF	TC	DC	R		
6867	o	Sl	+	+	+	..	Ce	No	Exami	nation			....	Ce to TC, inclusive
7644	+	Sl	..	..	..	..	Ce	o	o	o	o	o	....	Generalized
10068*	+	..	..	..	..	..	Ce	o	o	o	o	+	....	Ce, AC
8215	+	o	+	+	+	+	Ce	o	o	o	+	+	....	Generalized
10091*	+	o	+	+	..	..	Ce*	o	o	o	o	+	....	Ce, AC
9315	+	+	+	+	+	..	TC ?	o	o	o	o	o	....	None
9562	+	+	+	+	..	..	Ce ?	o	o	o	o	o	....	Ce
8245	+	Sl	Sl	Sl	+	..	Ce, TC	o	o	o	o	o	....	Ce, TC
9382	o	+	+	+	o	+	Ce	o	o	o	o	+	Ce ?	Ce, Ceco-colon
9068	+	+	+	..	..	..	Ce	o	o	o	+	+	Ce	Ce, Ceco-colon
5075	+	+	+	+	+	..	Ce ?	Sl	Sl	o	o	Sl	Ce	Ce, Ceco-colon
7588	+	Sl	Sl	+	+	..	Ce, TC	o	o	o	o	o	Ce, TC	Ce to TC inclusive
8985	+	..	..	..	..	..	Ce	Sl	+	..	..	..	....	IL, Ce to TC
5045	+	Sl	Sl	..	..	..	Ce, HF	o	o	o	o	o	Ce, HF	Ce, TC
7162	o	Sl	+	+	+	..	Ce	Sl	Sl	Sl	Sl	Sl	....	Ce
7348	+	..	..	..	..	..	Ce	o	o	o	o	+	....	Ce to TC inclusive
7366*	+	Sl	..	..	..	..	Ce*	No	Exami	nation			....	Generalized
7541	+	+	o	+	+	..	HF	o	o	o	o	o	....	HF
7739	+	?	..	..	..	..	Ce ?	o	o	o	o	+	....	Ce
7822	+	Sl	..	..	..	..	Ce, HF	o	o	o	+	+	Ce	Generalized
4909	+	Sl	..	..	..	..	Ce, HF	o	o	o	+	+	....	Il, Ce, AC
8544	12	Hour	Exami	nation			....	o	o	o	o	+	Ce ?	Generalized
8873	+	+	Sl	Sl	+	..	Ce	o	o	o	o	+	Ce	Ce, Ceco-colon
7093	+	+	+	+	+	..	C, TC	o	o	o	o	o	Ce, TC	Ce, TC
5096*	o	o	o	o	+	+	Ce*	o	o	o	o	o	Ce ?	Generalized
9135	+	+	+	..	..	..	....	+	+	+	+	o	....	Ileum.

* In the above cases marked with an asterisk the cecum was assumed to be involved, as it was never visualized during the fourth to the eighth hour examinations, and as complete emptying of the bowel occurred in twenty-four hours.

6. This method should be used in studying all patients with advanced pulmonary tuberculosis and all suffering from any abdominal symptoms, or who have failed to respond to treatment for the pulmonary disease.

7. This study is based on 175 cases, of which 44 were positive, 32 doubtful and 99 negative for tuberculous colitis, and on 28 cases operated upon, of which 27 upheld the diagnosis.

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DISCUSSION

Dr. L. T. LeWald.—I wish to give what confirmation I can to this work from a very careful study of Dr. Brown's original plates. I made two trips to his laboratory, and my attention was called to this in June by Dr. Brown and Mr. Sampson, and I believe that we have here an absolute method of diagnosing tuberculous lesions of the colon. While some other pathological change in the colon might give the same thing roentgenographically, when associated with pulmonary tuberculosis the diagnosis seems warranted. There is no reason why other lesions would not give the same appearance, for example chronic amebic dysentery.

Dr. George E. Pfahler.—I have been very much interested in this study ever since Stierlin's article, which was published in 1911. By pure accident this summer while I was touring through the Adirondacks I dropped in at Trudeau and saw the wonderful work that the men are doing there; everyone should visit them when they have the opportunity. You will always find them courteous and willing to help. By accident I didn't know they had been doing this work. I missed a paper they read at Atlantic City. Mr. Sampson was just reviewing his cases when I got there, and I thought it would be a shame if this organization did not see these plates. I wrote Dr. Brown to see if this paper could be placed on the program and called Dr. Brown on the telephone. He and Mr. Sampson are very kind in presenting this paper.

I am sure we are all indebted to them. We must remember this thing: At Trudeau there are a group of tuberculosis experts that are dealing with a group of tuberculosis cases, and we must not run wild on this evidence. Those of us who receive our patients from practitioners and do not have the association of experts in tuberculosis should remember that the irritability of the colon must be persistent, and emptiness of the colon must be persistent. Do not jump to the conclusion that if you find part of the colon empty even on two days it means tuberculosis. It must be persistent emptiness, and it must persist when you inject the colon by rectum. It must be irritable and persistently emptying itself of the opaque meal and it must empty persistently locally after injection of the colon.

I would like to ask how many of these cases came to operation, and just what the surgeons did—of what the operation for this condition consists. I was interested, as I am sure all are, in the case that was opened up and nothing done, and then went down to Ashville and got well. I know that a number of cases of tuberculous peritonitis are opened and then get well and nobody knows why. It may be the same influence in these cases where nothing is done.

Dr. A. H. Pirie.—The presentation of these cases gave me great satisfaction. I remember when Dr. Archibald had none at all; when he sent the first one to me I didn't know that it would lead to all this work being done. The first case I did, I missed the cecum completely. The second one I also missed; and when I missed the third one I began to suspect. In the fourth case I spent a long time watching for the cecum to fill and when I found that it would not fill up I suggested that this was the diagnostic point. Soon after forming this theory I examined a case of suspected tuberculous cecum in which the cecum filled perfectly and I suggested that it was not a case of tuberculous cecum. At operation it was found that the cecum was not tuberculous.

There is a general principle applicable in such cases, viz., that the non-retention by the cecum of barium depends on its irritability. On the same principle if a man has a sore mouth, he will not keep his food long in his mouth; if he has a sore duodenum, he won't have a permanent cap; if he has a sore cecum, he won't retain food in his cecum, and so on all the way down the alimentary tract. It is quite possible that in some early cases of tuberculous cecum, the cecum is not sufficiently irritable to refuse to allow the barium meal to collect in it.

I would like to ask Dr. Brown if he agrees with that statement. In cases where the cecum fills with barium, is it not a fact that those are early cases of tuberculosis? Has he ever seen in an advanced case the cecum filled with barium? The essential thing in the diagnosis I consider is the fluoroscope, so that one may watch the barium leaving the ileum and collecting beyond the cecum.

Dr. Thomas A. Groover.—Yesterday we attempted to show by an analysis of 1300 cases referred to us for gastroenterological examination that seven per cent had tuberculosis. Dr. Brown has perhaps given us a reason why so many of these cases fall into our hands—that there is in all probability a tuberculous lesion of the bowel associated with the pulmonary lesion. Now we have recognized some disturbance of the colon in a good many of these cases, and have suspected the presence of a tuberculous colitis largely by inference, knowing that the patient had a pulmonary tuberculosis, but have failed to recognize anything specifically diagnostic in the roentgenographic appearance of the cecum and colon. I am sure that hereafter we will pay much greater attention to this, and I feel that Dr. Brown's presentation of this subject is of very great importance, and undoubtedly explains why so many of these tuberculous patients fall into the hands of the gastroenterologists.

Dr. Lawrason Brown.—In answer to Dr. Pfahler I would say that the operation of Dr. Archibald is the best I know for these cases. No one has done so much as he, and he and I have discussed it very frequently. What led me to discuss it with him was the idea that occurred to me that in the use of artificial pneumothorax, all we did was to give the lung rest. In intestinal tuberculosis there was no way to give the intestines rest. I think you can defend this statement successfully; that in so far as you can give any organ functional rest, so you can enable it to recover from tuberculosis. Now as you cannot give the intestines rest, operation seems to be the only treatment for the disease. At first we thought that short-circuiting would

fill the bill. In a few cases it does, but in advanced cases the condition is often most deplorable after operation. I feel to-day that if the condition is extensive, it is wiser not to try short-circuiting but to remove the appendix and close the abdomen. If the condition is localized and you can remove it in toto and the lungs can stand it, I should advise excision.

In regard to Dr. Pirie's question, I think he is right in regard to the enema. We have proved two cases to be tuberculous in which the enema didn't reveal anything abnormal; but in regard to the meal we do not feel that this occurs often. We feel that there is always some filling defect and hence infer some spasm. I have thought in view of the case that went down to Ashville that there might be a superficial ulceration that might lead to hypermotility and spasm, and that some of these cases might heal when the ulceration was superficial. We are not advanced far enough along this line to speak positively, but Dr. Archibald will have a number of contributions to make regarding this subject.

Dr. D. R. Bowen.—I am sure we appreciated this very much. I am going to ask Dr. Pfahler to offer a motion to thank Dr. Brown.

Dr. Geo. E. Pfahler.—I would like to make a motion to have a vote of thanks given to Dr. Brown and to Mr. Sampson for their most kind presentation.

Motion seconded and carried.

TELEROENTGENOGRAPHY OF THE HEAD*

BY P. M. HICKEY, M.D.

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GRANTED that a radiograph which is presented for interpretation should be technically as perfect as possible, it follows that in order to attempt to realize this ideal result, distortion should be eliminated as far as practicable. In plates of the head, the thickness of the part introduces a factor of distortion, which can be minimized by increasing the plate target distance. In order to keep the time of exposure as low as possible, the plate target distance should not be prolonged beyond practical limits. Desiring to determine the practical plate target distance for the varying exposures of the head, the following experimental plates were made: A piece of wire netting with a ¼ inch mesh was placed ½ inches from the plate. Successive exposures were then made with a target plate distance of 20, 24, 28 and 32 inches. At first glance the negatives presented a somewhat uniform appearance. It was found, however, that at 20 inches the distortion was 10 per cent, at 24 inches 8 per cent, at 28 inches 7 per cent, and at 32 inches, 6½ per cent. From this series of plates we may deduce the conclusion that mastoids should be made at a plate target distance of thirty inches.

In order to determine the approximate distance at which plates of the sella turcica should be made, the wire netting was placed at a distance of 3¼ inches from the plate. Serial exposures were then made with a plate target distance of 16, 24, 32 and 40 inches. It was found on measuring the negatives that the wire mesh at 16 inches showed 23 per cent distortion. Negatives made at 24 inches showed 14 per cent distortion. The negative at 32 inches showed 10 per cent distortion, and the negative made at 40 inches showed 8 per cent distortion. From this series of plates, we may deduce the conclusion that plates of the sella turcica should be made with a plate target distance of at least 36 inches. In order to determine the plate target distance for plates of the entire head, the wire netting was placed at a distance of 6½ inches from the plate and a series of exposures were made at a distance of 20, 28, 36 and 42 inches. The negative with a plate target distance of 20 inches showed 36 per cent distortion. The negative with plate target distance of 28 inches showed 28 per cent distortion. The negative with plate target distance of 36 inches showed 23 per cent distortion. The negative made with target plate distance of 42 inches showed 20 per cent distortion. From this series we may deduce that plates of the head, which are designed to show pathology of both tables should be made with a plate target distance considerably more than 42 inches.

The next experiment was made with a dried skull. Three sets of stereoscopic exposures were made at a plate target distances of 20, 36, and 48 inches. The lantern slide of one of each of these sets shows graphically the distortion which ensues with a 20-inch target plate distance. On the other hand at 48 inches the shadow of the inner table approaches quite closely to the normal size. The 48-inch set when viewed stereoscopically shows the right and left sides of the skull with about equal distinctness, and the cancellous tissue more remote from the plate compares favorably in clearness with the opposite side. Consequently, in a set of stereoscopic plates of the head made at a plate target distance of 48 inches any lesion, traumatic or non-traumatic, of either side would be equally portrayed.

In viewing this set a number of important details become well visualized which need only be mentioned, namely, the differentiation of the right and left clinoidal processes, the spacial relation of the

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ethmoid cells, and the graphic distinctness of the maxillary and sphenoidal sinuses. From these plates we may deduce the conclusion that a plate target distance of 48 inches is essential for the proper radiographic study of the entire skull.

Inasmuch as the distance of the sphenoidal sinuses and ethmoidal cells from the plate is never greater than 3½ inches, it follows that for stereoscopic plates of the sinuses, the plate target distance need not be more than 36 inches. However, with a plate target distance of 48 inches, the stereoscopic effect is enhanced and the ideal result more closely obtained.

In stereoscopic exposures made at a plate target distance of 48 inches, the displacement of the tube between the first and second exposure should be from 4½ to 5 inches.

In applying the technic, which seems advisable from these experiments, two problems present themselves, namely, (1) the length of exposure, and (2) immobilization of the head. The long exposure may be made with a tube having a focal point sufficiently broad to withstand the heat generated during such a long exposure, and by the use of double-coated films sandwiched between two screens, the necessary time may be reduced by the factor of one-sixth. This factor would necessarily vary with the various makes of intensifying screens. It is desirable, however, that the tube manufacturers furnish a tube which would stand the long exposure. Such a tube would necessarily have a broader focus than could be chosen for less difficult parts of the body. In order to obviate the changing of tubes, it is suggested by the writer that the tube stands be arranged with a small revolving turntable so that the radiographer could change his tubes from a fine to a blunt focus with the same ease as the microscopist changes his objectives by means of a nose piece attached to the microscope.

The second difficulty in teleradiography of the head is immobilization during long exposure. As it did not seem practical to lengthen the cone to the distance which would permit of pressure from the cone at a plate target distance of 48 inches, and as immobilization by bandages is not agreeable to the patient, the writer makes use of a sheet of celluloid 11 x 14 inches with its edges reinforced by metal and capable of fixation by means of appropriate set screws. This sheet of celluloid placed between the tube and the patient can be adjusted so as to keep the patient's head firmly pressed against the plate holder. The elasticity of the celluloid enables it to conform slightly to the roundness of the part. With patient's head thus immobilized, the tube and cone can be placed at any desirable distance or angle. If it is desired to make use of a second or auxillary diaphragm, a piece of lead with proportionately sized opening can be placed on the celluloid. This arrangement gives all the advantages of a long cone without disadvantages of additional weight. The celluloid being clean and transparent is not objected to by the patient and, furthermore, allows more accuracy in determining the angles of the head in relation to the plate and the central ray. The lantern slide will perhaps show this construction and its application better than the description.

CONCLUSIONS

1. To prevent distortion in head plates, the plate target distance should be increased to the practical limit.

2. Plates of the mastoid region should be made with plate target distance of at least 30 inches.

3. Plates of the sella turcica should be made with plate target distance of 36 inches.

4. Stereoscopic plates of the head, whether made in the lateral or postero-anterior direction, should be made with the tube plate distance of at least 48 inches.

A SAFETY DEVICE FOR X-RAY TUBES*

BY GEORGE C. JOHNSTON, COLONEL M. C. U. S. A.

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THE advent of the modern transformer of large capacity, together with auto-transformer control, has introduced an element of great danger in the practice of roentgenology. Transformers having actual ratings in excess of 6 kilowatts are in common use. The Coolidge tube permits the employment of power greatly in excess of that formerly employed.

Many exponents of deep therapy advocate the employment of voltages as high as 90,000. Under such circumstances, accidental contact with any portion of the excited tube circuit may be expected to result in the discharge of an enormous rush of electrical energy through the object coming in contact with the lines, provided such object is a conductor. It is, of course, not necessary to come in actual contact with any portion of the circuit. Approaching within four to five inches is quite enough. The greater portion of the circuit in a modern installation is composed of aerial lines more than six feet above the floor, but the conductors leading to the tube and the terminals of the tube itself are invariably exposed, and this is the portion of the circuit which, of necessity, in either treatment or radiographic work, is brought into the closest relation with the body of the patient and the head, arms and trunk of the operator.

A recent fatal electrical accident, due to a discharge from the terminal of a tube through the head of a patient to the tube stand and thence to the ground, resulted in attempts at the construction of a protective device which it was hoped would obviate any such future occurrences. The unfortunate individual in the instance referred to had been examined previously and was familiar with the procedure. The accident resulted from a deliberate disobedience of instructions on his part. Having been placed upon his knees with his elbow upon the table for the purpose of determining the condition of an injured elbow joint, and having been cautioned to remain perfectly still, he suddenly, during a one second exposure, partially arose to his feet bringing his head in contact with the cathode end of the tube, whereupon the discharge occurred from the tube terminal to his forehead and emerged through the ear to the tube stand and thence to the ground. In this particular instance, the grounding of the tube stand, of itself a safety measure, introduced an additional element of danger.

In all safety engineering, the following principles are well recognized:

(*a*) All safety devices are presumed by those who come in contact with them, and by the public generally, to give 100 per cent protection.

(*b*) They are presumed to be at all times in perfect working order.

(*c*) Due to the presence of the safety device, additional liberties are presumed to be safe. These traits of human nature must be admitted and taken thoroughly into account in the consideration of any form of safety apparatus.

In the design of the apparatus under discussion, the procedure was first to design and construct a device which, when attached to a tube stand, would render it impossible to come in contact with any electrified portion of the apparatus, the tube, or its conducting wires. A shield necessary to prevent mechanically such contact must, of necessity, be metallic and grounded to the tube stand. With such a device attached, there was no possibility of an electrical discharge occurring from any portion of the tube to any person in its vicinity. Such a device would give absolute protection; but it would be

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so large, cumbersome and heavy that it would interfere with the proper functioning of the tube stand. If it were reduced in size, so that it would not interfere with the functions of the stand, it would then be necessary to insulate it completely from all high tension portions of the apparatus. Immediately there arose the difficulty of securing insulating material which would stand the great difference in potential between the tube and its metal shield. Bakelized fiber of sufficient thickness was found to be capable of withstanding the stresses involved. Moreover, a failure of the dielectric would result in inability to operate the tube at high voltages, but the 100 per cent safety factor would remain unchanged. This is the important feature of the invention. The device, if in place, is operative. Breakdown does not diminish the safety. Several modifications in design were necessary before it was possible to produce what is here shown; namely, a device capable of giving absolute protection and capable of operating successfully up to voltages higher than those which can be obtained from any of the modern types of transformers. The device consists of tubes of bakelized fiber closed at one end, into which are introduced the extremities of the Coolidge tube. These tubes are covered by, and supported by means of, sheet metal members which attach to the tube stand. The ordinary tube clamps are dispensed with. The cathode tube is provided with a screw socket having a plunger actuated central electrode. The 12 volt current necessary for the heating of the filament is led into this socket. The Coolidge tube having been screwed in may be given a complete revolution after electrical contact is made. The socket itself is spring supported. Hence, any inequality or variation in the construction of the cathode end of the tube is taken care of. The anode end of the tube slips into a similar bakelized fiber metal supported tube containing in its inner end a three-fingered spring support which grasps the end of the tube, and to which is conducted the positive lead from the transformer. Both the cathode pair and the positive lead are brought into the

FIGS. 1 AND 2. ILLUSTRATING SAFETY DEVICE FOR *X*-RAY TUBES.

large fiber tubes through a thick walled small fiber tube some 15 inches in length. The joint between the smaller and larger tubes is secured by means of a deep thread and insulating compound. Thus all portions of the tube and a liberal distance along the leading-in wires is effectively protected and accidental contact with electrified portions is impossible. The device adds but little to the weight of a tube-stand, and does not interfere in any way with the manipulation, or operation of tube or stand. It, moreover, interposes an efficient and much needed shield when the ordinary type of tube is used in the slotted lead glass bowl. Many unfortunate cases of dermatitis have occurred from stray radiations leaking out through these slots at either end of the tube bowl.

The device for the shielding of the radiator type of Coolidge tube is under construction and presents but few difficulties, inasmuch as these tubes are designed to be used with voltages not in excess of 60,000. The principles employed are the same.

The United States Government has made application for a patent upon this device and it will be employed upon all *x*-ray apparatus in the military service.

DISCUSSION

Dr. Byron C. Darling.—I would like to ask Dr. Johnston what he thinks of a breaker in the main circuit as a safety device.

Dr. George C. Johnston.—There was a circuit breaker on this machine and it is a G. E. breaker, 500 volts, the quickest tripping thing I ever saw. It was set to trip on a small load, but it did not go out. The whole thing is this: there must be no time factor in a safety device. We have moving parts in a circuit breaker and it takes *time* to get them moving. But it does not take any time for an electric current to go through a man and kill him before the breaker would throw out.

Mr. H. W. Dachtler.—I am sorry Dr. Johnston did not go one step farther and devise a wire that would not break.

Dr. George C. Johnston.—We have it in the army, a reel wire that you can hang yourself with, and it won't break. That is one of the things we got after just as soon as we started to have *x*-ray apparatus built. The reel wire that is used in the Army is modelled after a hoisting rope, that is a seven strand rope wound around a canter; you can't break it.

Dr. G. E. Pfahler.—Who makes it?

Dr. G. C. Johnston.—I am not going to advertise it; you can ask the manufacturers.

Dr. H. W. Dachtler.—We have always worked in our therapy work with overhead reels. Fortunately wires break at the hook, and with the reel supported overhead the wire cannot drop on the patient, but in this wire cable the fact that it is attached to a hook is a measure of uncertainty, but if it breaks at the hook, the wire cannot drop on the patient; it will always fly up.

Dr. L. T. LeWald.—I would like to ask about the cause of death, whether there was an autopsy, about the pathological changes. I performed an autopsy on a case of electrocution from low tension on a man who stopped the Broadway line, and he had distinct punctate hemorrhages in the brain, and that was the type of lesion—explosive lesions of the nerve cells with hemorrhages into the cells. In this case it would be interesting to know whether there was such pathology present.

Dr. A. H. Pirie.—I would like to ask whether this is the only fatal case which happened and I would like to ask if there are any other cases on record.

Dr. G. C. Johnston.—This is the only fatal accident I have any record of. One man got a severe burn on the leg. One boy walked into a high tension wire, and the muscular contraction made him leap like a frog, but there were no other serious injuries that I was able to get any report on. Those things are not usually reported.

Dr. G. E. Pfahler.—Where can you get this device?

Dr. G. C. Johnston.—They will be on the market probably within a couple of months.

MULTIPLE MYELOMA OF BONES*

BY WM. A. EVANS, M.D.

DETROIT, MICH.

MY excuse for presenting this subject is the complete absence of references to it in the Roentgen Literature and to the indifferent mentioning of the roentgen findings in cases reported from the purely medical aspects.

The paper is based on our observation of three cases during the past two years of a widespread neoplastic involvement of bone structures. The cases at the time of examination were reported as malignant neoplasm, with no attempt made to classify accurately the type of malignancy, other than that it was suggested that the findings were atypical of either sarcoma, carcinoma or infection.

FIG. 1. PLATE 1, CASE II.

Note extensive destruction of the upper end of humerus, with involvement of clavicle, scapula and ribs.

CASE I.—The records are incomplete, owing to a failure to obtain an autopsy. The clinical diagnosis was pelvic tumor of rectal origin. The roentgen examination was confined to the pelvic structures, the plates showing a malignant new growth of bone origin. The pathological report was myeloma of the plasma-cell type.

CASE II.—Male, age thirty-seven, January, 1918. The patient entered the hospital for relief of pain in the back and chest, the condition having been progressive for five months. The general physical and the special examinations were negative with the exception that in addition to the cachexia, there was swelling over the anterior aspect of the left shoulder, the mass being immovable and nonsensitive, and showing no heat or redness. There was also a small mass of the same character at the inner third of the left clavicle.

FIG. 2. PLATE 2, CASE II.

Same demonstration of bone lesions as on plate I. Note absence of lung involvement and absence of lime disturbance.

CASE III.—Male, age forty-six years; examination January, 1919. Patient was

* Read before the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3–6, 1919.

referred for examination of the gastro-intestinal tract with the tentative diagnosis of malignancy, this being based on the history of a 40-pound loss in weight. The only positive findings at this time were in connection with the teeth, where there were extensive apical abscesses, and an increase in the width of the aortic shadow which we suggested was due to lues. This case entered the hospital four months later. In the meantime there had developed severe pains in the back and chest, and the emaciation had progressed rapidly, the total loss of weight at this time being 70 pounds. The general examination was negative. The special examinations revealed a positive Wassermann. The roentgen examination demonstrated a widespread bone lesion which was interpreted as carcinomatosis.

A complete autopsy of both cases (II and III) showed that the lesions were confined to the osseous system, there being numerous tumors of varying sizes. Their consistency was usually soft. On section the new growth was seen to replace the marrow, and in many places the growth had broken through the cortex and appeared externally as nodules. The flat bones, like the sternum and ribs were flexible, containing very little bond. In the case of the sternum, there was almost complete absence of calcium, so that the structure could be cut easily with the ordinary shears. In case II, there was a pathological fracture both at the upper end of the humerus and at the lower third of the femur. The pathological diagnosis in both cases (II and III) was multiple myeloma of the bones with no involvement of the thoracic or abdominal organs.

FIG. 3. PLATE 1, CASE III.

Plate made at the time of the first examination. A negative report was made, but a careful scrutiny reveals early lesions.

FIG. 2. PLATE 2, CASE III.

Note extensive involvement of the ribs and clavicles. Also note the absence of pulmonary involvement.

MacCallum in his textbook gives the most satisfactory definition of the condition: A myeloma is a growth springing up in the bone-marrow and evidently occurring as a systemic affection of the marrow cells since it appears simul-

taneously in many bones and nowhere else. In Ewing's "Neoplastic Diseases," McIntyre is given credit for first describing the disease, this being done in 1850 under the term of "Mollities Ossium," and Rusticky (1873) for recognising it as a specific affection of the bone marrow, he classifying it as a "Myeloma."

The etiological factor in the condition has not been determined. One author mentioned trauma as a basis for the condition, but he presents nothing to support the view. Others maintain that the condition is a late or indirect sequel of an infectious process, one case having followed typhoid. Several cases have indicated a dependence on nutritional disorders of bone disease which in other subjects lead to osteitis or osteomalacia. The disease occurs most frequently in middle age, and the proportion between males and females is about three to one.

Fig. 5. Plate 3, Case III.

Note extensive involvement of the spinal segments, sacrum and ilium.

The symptomatology of the cases reported in literature coincide accurately with the records of the cases which came under our observation. There are pains in the chest, back, groin and thigh, with increasing weakness and progressive loss of weight. The course of the disease usually extends over a period of from six months to two years, the symptoms being uninfluenced by treatment, and always having a fatal termination.

The literature deals largely with the histogenesis and the disturbance in calcium equilibrium and the presence in the urine of the Bence-Jones protein. Uncertainty and a lack of unanimity is evident in regard to the true classification. The majority of the observers are agreed that the neoplastic cells are derived from the blood-forming cells of the bone-marrow and are related to the primary diseases of the lymphatic and hemapoietic apparatus.

Ewing in the volume mentioned above gives an excellent classification which I believe is the one generally accepted at this time by the majority of pathologists. This classification gives four groups:

1. Plasmocytoma
2. Erythroblastoma
3. Myelocytoma (Adult and embryonal)
4. Lymphocytoma

It is this difference in the type of cell producing the growth which explains the variation in the description of the condition by the several authors. It would also serve to explain why it is held by some that metastasis may occur in tissues of the body other than bones. Our three cases were all of the plasma-cell type and accordingly the growths were limited to the osseous system.

DISCUSSION

Dr. L. T. LeWald.—I have one case that illustrates a great many of the points brought out by Dr. Evans and yet has certain other features that are exceedingly interesting. It is a case of myeloma in which the microscopic diagnosis was made by Dr. Ewing, and yet two other pathologists regarded the tumor and sections of it as round-celled sarcoma. This case is of considerable interest because of the long course it ran, over a period of four years.

The patient finally died three months ago and came to autopsy and the diagnosis was confirmed by sections. Although it ran its course as a one bone myeloma, just prior to death, as the autopsy showed, secondary deposits were found in other bones, namely, in the ribs and clavicles, and metastases were also found in the spleen, liver and heart, which shows a different condition from what Dr. Evans said of metastases, namely that they rarely occur in the solid organs.

Then in regard to its course and etiology: this man had a fracture two years prior to the time a diagnosis of myeloma was made. At that time an *x*-ray was not made, and I do not know whether it was a pathological fracture or a trauma which led up to the starting of the malignant diseases.

I am inclined to think that what he had was a pathological fracture and six months later another fracture. On postmortem examination it was found that union had taken place in the pathological fracture.

Those of you who are familiar with this type of tumor will see from the lantern slide that it is made up of large round cells with large nuclei. There is a difference of opinion among pathologists, but Ewing thought because of this cellular type of tumor it would yield to *x*-ray treatment. Dr. Pfahler also made that suggestion. The patient was given *x*-ray treatment and improvement occurred.

Successive slides of the case before and after treatment and as recently as six months ago show a considerable increase in density of the bone and filling in with lime salts, so that we thought the man was actually going to save his arm. But within six months of that time he died with secondary growths in the organs I have described. It is a type of tumor that is of considerable interest and has perhaps not been studied as much as the sarcomata.

Dr. G. W. Holmes.—The diagnosis in this type of tumor is, I think, a difficult one to make. A point which I have not heard brought out in the discussion is the presence of Bence-Jones bodies in the urine in this disease.

Dr. L. T. LeWald.—Early in this case Bence-Jones bodies were not found, but at the terminal stage they were present.

Dr. Wm. A. Evans.—I believe that the slides shown by Dr. LeWald do not demonstrate the same lesion shown on the plates illustrating my article.

In the slides we have just seen, there was a bony overgrowth, but in cases of true multiple myeloma the lesion is one which is produced by an extension outward of a growth which begins in the medullary portion of the bone, the cortex being destroyed by pressure of the expanding new growth. Dr. LeWald's case was undoubtedly one of sarcoma, while multiple myeloma should not be so classified, it being a distinct entity.

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ADDITIONS TO EDITORIAL BOARD

It gives the JOURNAL much pleasure to announce the addition to its Editorial Board of the names of Professor A. Béclère, of Paris, Sir Robert Knox, of London, and Doctor R. Ledoux-Lebard, of Paris.

There is no need formally to introduce these gentlemen to Americans who habitually peruse the world's literature dealing with the subject of *x*-rays. In the minds of those of us whom the war brought in direct contact with French and British radiologists, these names will rekindle delightful memories.

Thus is created a closer relationship between American roentgenology, through the official organ of our National Society, and representative scientists and teachers of the European schools. This is a step nearer the new internationalism among scholars upon which the JOURNAL has already commented editorially.

The patriotic activities of our new collaborators in contribution to the science of the radiology of war, will go far to stimulate the further scientific researches of peace. PERCY BROWN.

ROBERT WILSON, LIEUTENANT COLONEL C. A. M. C.

After an operation in St. Andrews Military Hospital in Toronto, from which he never rallied, Lieut.-Col. Robert Wilson passed away on Saturday morning, November 1st.

The news of his death came as a great shock to his many friends in Montreal where he had practised for many years. The illness from which he suffered had given him cause for anxiety for a long time, but true to his profession and to his country he gave himself unstintedly to the work of rebuilding and reclaiming for civilian life those whom the shock of war had deprived of the full use of their muscles and limbs; and it was not until the work was about completed that he consented to take time to care for himself. By this time it was too late and the best medical skill in Canada was unable to save him.

Dr. Wilson was a native of Montreal. He graduated from McGill University in medicine and began to practice in Pt. St. Charles. For years he was one of the G. T. R. Surgeons, and filled an important position on the Staff of the Western

Hospital, especially in the Department of Electro-Therapeutics and x-ray. He was a pioneer in x-ray work in Canada, and for his labors in that branch of the service is well and favorably known. For a number of years he was Professor of Pharmacology and Electro-Therapeutics at Bishop's College, and it was while engaged in this capacity that he did much of the experimenting which served him in such great stead when the war brokeout.

LIEUT.-COL. ROBERT WILSON, C. A. M. C.

He proceeded overseas with the First Canadian Contingent as an x-ray specialist with No. 1 General Hospital, and with this Unit at Étaples, he remained for about a year. He was then recalled to London to the Office of the A. D. M. S., and given the task of organizing the new Department of Electro-Therapeutics with headquarters at Granville Special Hospital. The wastage of war was demanding that every effort be made to reclaim the use of muscles and limbs of which the war had deprived the soldiers, and Dr. Wilson, because of his special knowledge, was appointed to look after this. After this branch had been established and others had been trained for this branch he was called home to organize the work among those who were returning. He was appointed one of the Head Consultants of the C. A. M. C. and given full charge of the Department of Electro-Therapy in Canada with headquarters in Toronto. There he established the Military School of Physico-Therapy, where specialists were trained for all the military hospitals. This is the only institution of its kind in Canada.

Besides this special work, Dr. Wilson was a man well known in many other spheres of life. He was a life member of the Argyle Lodge No. 65 F. and A. M., was a Past Master of the Grand Lodge of Quebec, and a member of St. Matthews Presbyterian Church. He was also a member for many years of The American Roentgen Ray Society. He took a prominent part at the last meeting of this Society at Saratoga Springs, New York.

The sympathy of the Society is extended to his widow, Mrs. Helen Wilson. By his death it is deprived of one of its oldest and most experienced members, and Canada loses one of her foremost roentgenologists. A. HOWARD PIRIE.

EASTERN SECTION OF THE AMERICAN ROENTGEN RAY SOCIETY

ANNOUNCEMENT OF FIRST ANNUAL MEETING

The First Annual Meeting of the Eastern Section of the American Roentgen Ray Society will be held at The Traymore, Atlantic City, Friday evening and Saturday, January 30 and 31, 1920. The informal type of program heretofore so successful in the conduct of the Eastern Midwinter Meetings will be followed in the Section with two important exceptions.

Participation in the program will be limited to members of the Society and such others as may be invited to take part. Members are urged when possible to

have their discussions written for presentation to THE AMERICAN JOURNAL OF ROENTGENOLOGY. This is not, however, to be understood as interfering with the informal character of the sessions.

All physicians and students interested in roentgenology are invited to attend.

Communications regarding place on the program should be mailed to the President, Dr. H. W. VanAllen, 19 Maple St., Springfield, Mass.; those regarding other matters —exhibits, lantern slides, etc., to the Secretary.

To secure prompt attention, please address Dr. David R. Bowen, Secretary, 235 So. Fifteenth Street, Philadelphia, Pa.

Reservations of rooms should be made directly with The Traymore.

AMERICAN ASSOCIATION OF ELECTROTHERAPEUTICS AND RADIOLOGY

ANNOUNCEMENT

The Annual Meeting of the American Association of Electrotherapeutics and Radiology was held at Philadelphia, September 16, 17, 18 and 19, 1919. The following officers were elected:

President

William Martin, M.D., Atlantic City, N. J.

Vice-Presidents

Virgil C. Kinney, M.D., Wellsville, N. Y.
William T. Johnson, M.D., Philadelphia, Pa.
S. St. John Wright, M.D., Akron, Ohio.
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The next meeting will be held in Atlantic City, N. J., September 14 to 17, 1920, inclusive.

TRANSLATIONS & ABSTRACTS

ANDREW J. GRANT, Diaphragmatic Hernia. (*British Med. Jour.*, September 27, 1919. No. 3065.)

The history of the case is interesting as showing the amount of unnecessary hardship inflicted upon a long-suffering and patient soldier by a failure to recognize the great diagnostic value of *x*-ray examination.

B. M., a rifleman, aged twenty-two, was shot by a sniper while occupying a captured German trench. The bullet entered the left side of the chest behind and immediately below the twelfth rib, 2½ inches from the mid-line and was extracted from under the skin on the following day at a point 2 inches below and 1 inch to the inner side of the left nipple line, a through and through wound. The bullet, as frequently happens, had turned round and was pointing base uppermost.

Several months were passed in a general hospital and convalescent home before he was considered fit to return to his regimental depot, which he did about the middle of July, 1917. He complained at his depot that he suffered much pain after food of any description and that he was frequently sick. His statements were disregarded and he was given "medicine and duty." In spite of his complaints he was sent back to France on July 27th, four months after receiving his wound. Every day while in France he suffered pain, and was totally unable to digest the ordinary army ration. He stuck until he could stand it no longer, and was carried down from the line too weak to go as a sitting case. He returned from France, sent home as a case of gastritis. That label has been his undoing. For seven or eight weeks he received treatment for gastritis, after which he spent thirteen weeks in a convalescent home, but without any improvement. He was then given ten days' leave, but on the second day returned sick. He was sent to a "mother hospital." Here also for weeks he was treated for gastritis. He was ultimately, fifteen months after being wounded, discharged from the service as a case of gastritis. After six weeks he came into the care of the author.

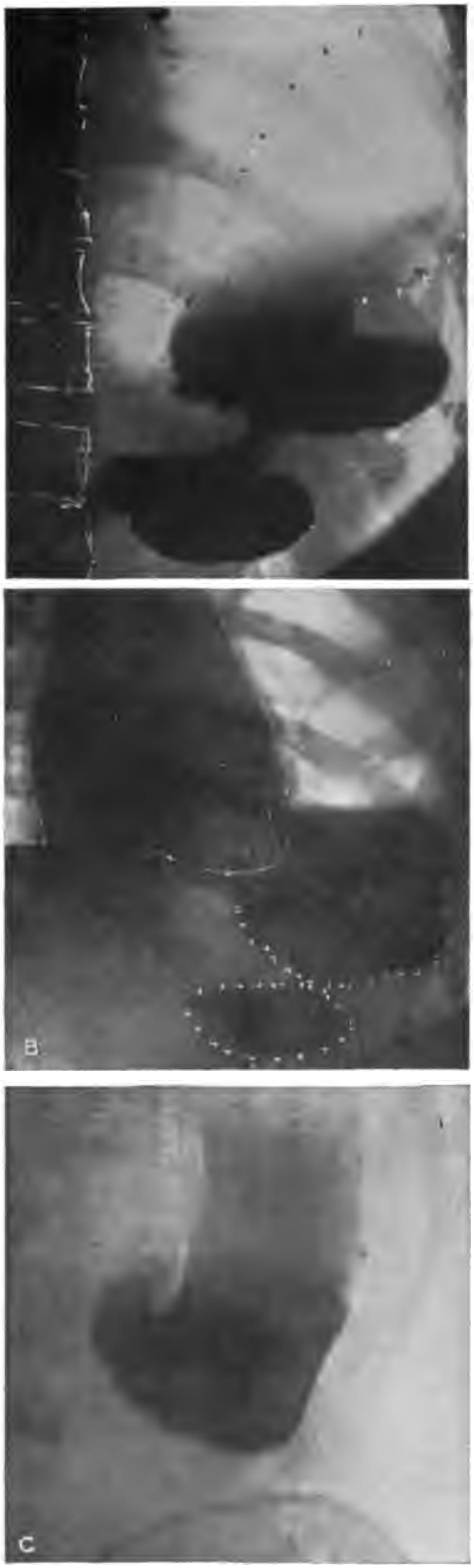
On admission it was noted that his general condition was unsatisfactory. Examination revealed the existence of scars in the left lower chest wall as above noted. The heart was slightly displaced towards the right, and was irregular in rhythm. The base of the left lung was dull to percussion, and the respiratory murmur was absent in the lower half of this lung, while râles were heard in the upper half and the greater part of the right lung. His constant complaint, however, was that of pain immediately or very shortly after food of any description was taken, and a feeling of great distention. From the situation of the through and through wound, my opinion at this stage was that the condition might be one of hour-glass contraction of the stomach following perforation by the bullet. The case was clearly one for examination by the *x*-ray.

The following is the report of the roentgen examination: The patient could only take part of the opaque meal and that with great difficulty. Skiascopic examination showed that three-quarters of the stomach was in the thorax. The portion remaining in the abdomen was connected to that above the diaphragm by a narrow passage. Practically all of the opaque meal could be made to pass back into the chest by having the patient turn on his right side in the prone position. The tone of the stomach was poor and peristalsis was not made out. The upper limit of the stomach was about the level of the third rib in front.

Fig. A is the skiagram taken before the operation. Fig. B another skiagram also taken before operation. Fig. C Skiagram taken some weeks after the operation.

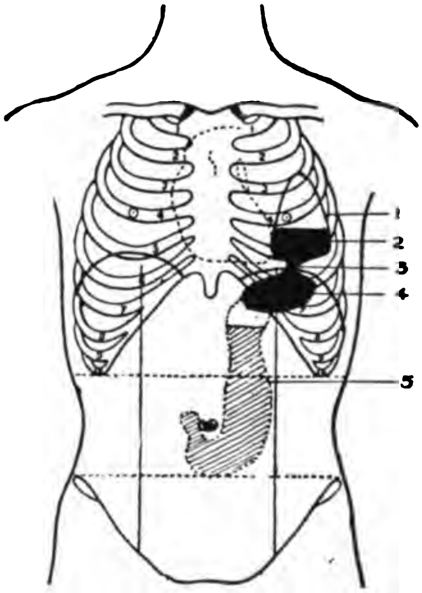
In the diagram the hatched outline shows the normal position of the stomach contrasted with the position of the patient's stomach before operation.

Upon the above findings the patient was operated on. The abdomen was opened, and the transverse colon immediately presented itself. No stomach was visible. It was then seen, by tracing up the bowel from the duodenum, that the entire stomach and great omentum, as indicated by *x*-ray, had disappeared and were on the other side of the diaphragm. With considerable difficulty the stomach was drawn back into the abdomen. The omentum had contracted adhesions to everything it came into contact with and a



portion had to be left in the chest. The opening in the diaphragm was closed with strong interrupted silk sutures. The stomach appeared thickened as though the wall had hypertrophied in the vain effort to pass the food on to the duodenum. His recovery was naturally slow, but was not complicated in any way. The wound healed primarily.

The most interesting point about the case is how the patient ever managed to survive the most extraordinary trials he must have gone through before he was recognized as a serious case.



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W. W. Belden, M.D.

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Paul B. Hoeber, 67-69-71 East 59th Street, New York